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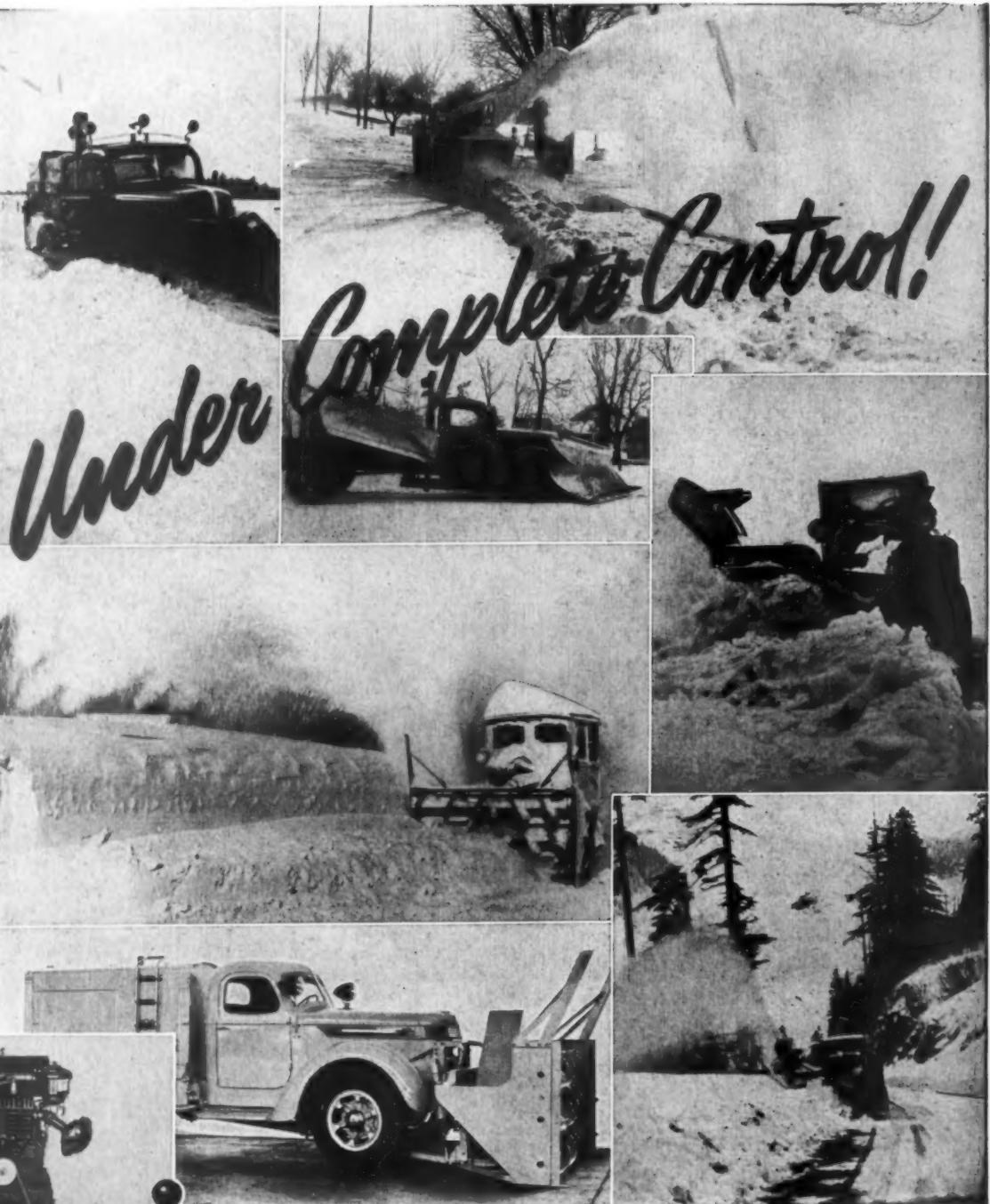
DETROIT

ROADS AND STREETS

DECEMBER, 1940



Rocky Cape Bridge on
Oregon Coast Highway
Courtesy of the Highway Dept.

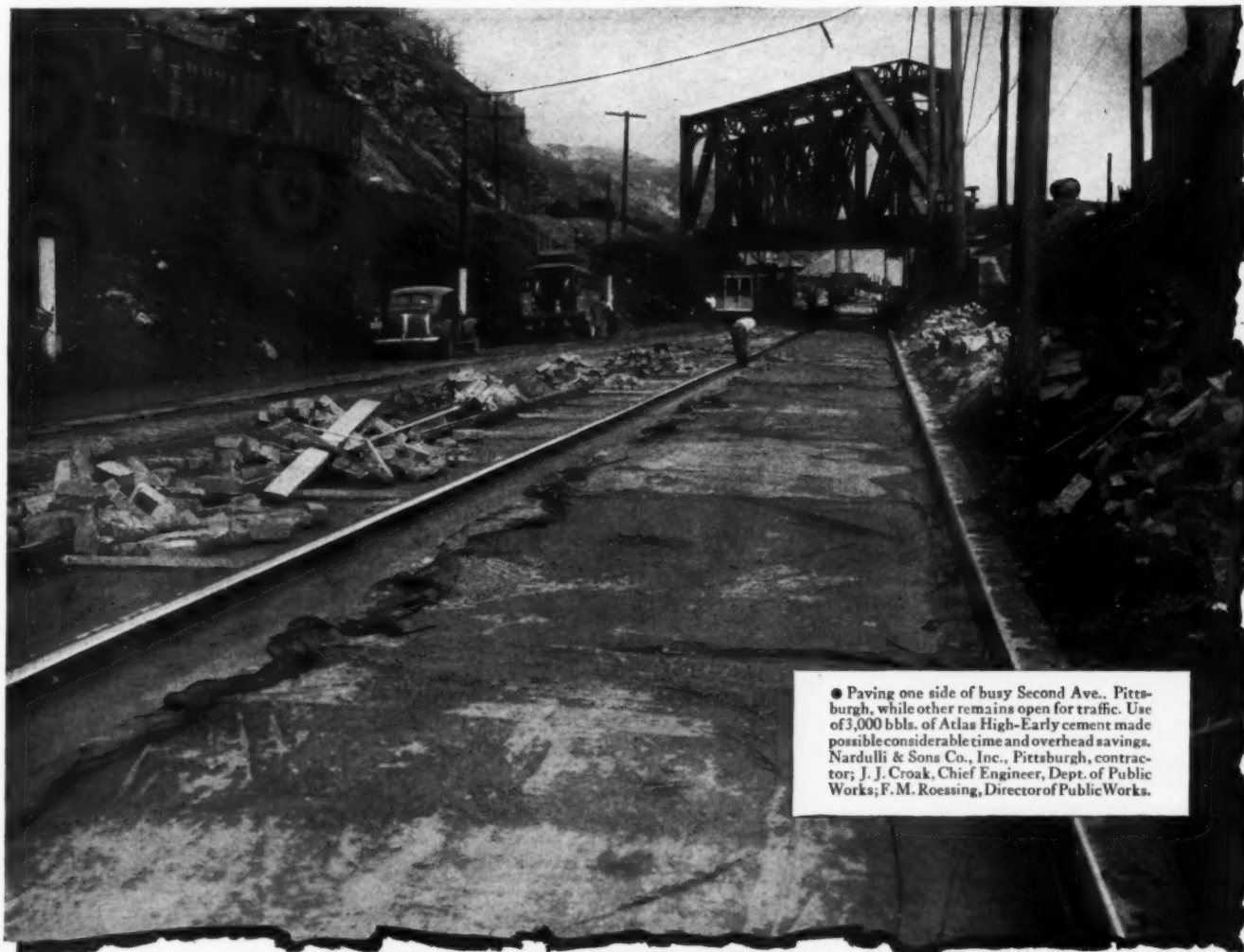


IT'S NO TRICK to keep highways open when your plows are hydraulically controlled by Blackhawk Power-Packers. Whether your needs are for power or hand control, Power-Packers assure dependable power for *speedy* and *accurate* raising and lowering of blades. Easily and quickly installed. Modernize your present equipment **NOW** — be prepared to keep your roads open and taxpayers happy. For complete list of advantages of Blackhawk Power-Packers write your equipment manufacturer — or write us direct.

A Product of BLACKHAWK MFG. CO., Dept. RS, Milwaukee, Wis.

BLACKHAWK
Hydraulic
CONTROLS

REWARDED FOR SPEEDING on a busy road!



● Paving one side of busy Second Ave., Pittsburgh, while other remains open for traffic. Use of 3,000 bbls. of Atlas High-Early cement made possible considerable time and overhead savings. Nardulli & Sons Co., Inc., Pittsburgh, contractor; J. J. Croak, Chief Engineer, Dept. of Public Works; F. M. Roessing, Director of Public Works.

THE extremely heavy automobile and street-car traffic on Pittsburgh's Second Avenue forced complete repaving. Problem was to get this job done in the shortest possible time, with the least possible traffic tie-up.

The contractor knew he could make a large saving in repaving time by getting rid of long protection and curing delays. So he used a cement that gains strength rapidly—Atlas High-Early

cement! First the base for one side of the road was concreted. Then—within a minimum amount of time—the contractor switched traffic and started concreting the other side.

The rewards? Each strip of road was ready for traffic much earlier than would otherwise have been possible. The job was done in winter weather, and so several days' protection and curing time was saved. Added up, these

items made a substantial time and overhead saving!

Speed up your road, bridge and other construction by using Atlas High-Early cement. Although this cement costs slightly more, the savings in time and overhead often more than pay for the extra cost. For more facts, write Universal Atlas Cement Co. (United States Steel Corp. Subsidiary), Chrysler Building, New York City.

BB-H-15

ATLAS HIGH-EARLY CEMENT

A UNIVERSAL ATLAS PRODUCT



ROADS and STREETS

With which have been merged GOOD ROADS and ENGINEERING & CONTRACTING

Published Monthly by
GILLETTE PUBLISHING COMPANY
330 South Wells Street
CHICAGO, ILLINOIS



THIS MAGAZINE IS DEVOTED TO
Design, Construction and Maintenance
of Highways, Streets, Bridges and Grade
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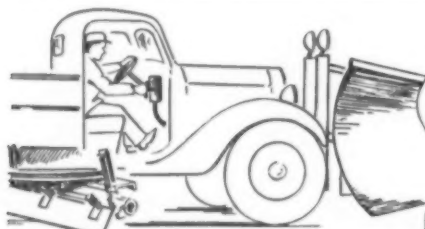
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Grand Rapids Michigan

Vol. 83

DECEMBER, 1940

No. 12

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"M" day IS HERE!

• "Mechanize" is the order of the day. That's why the Moto-Crane* is going great guns. Contractors took to this rubber-tired unit right from the start. Scores of them are now in service, handling jobs of every size, shape and description—and it's only the beginnin'!

The Moto-Crane is outstanding on three counts. It's 100% mechanized, being mounted on a Crane Carrier specially designed for highway and off-the-road travel. Secondly, the patented

sloping machinery frame gives Balanced Design in turntable. That's why this unit can handle big capacities with long booms and low booms (as evidenced above). And lastly, it's as versatile as a one-man band because readily interchangeable boom equipment permits operation as a crane, dragline, clamshell, shovel or backdigger.

The Moto-Crane is available in three sizes. Better get complete information now. Mechanized Moto-Crane service is here to stay.

UNIVERSAL CRANE DIVISION • THE THEW SHOVEL CO.
LORAIN, OHIO

*Trade Mark



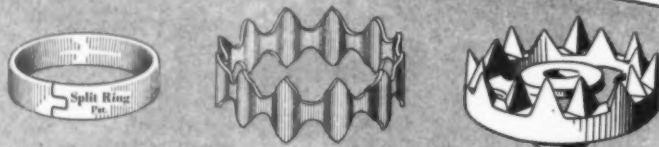
FACTS ABOUT THE CRANE • THE CARRIER

1. Simplified Center Drive direct-to-the-point power application.
2. Balanced turntable design, to provide the greatest capacities per pound of weight.
3. Steel erector's precision boom hoist with positive power control of boom lowering.
4. 2-piece, pin-connected, all welded boom with center sections and straight or goose-neck tips.
5. Cab type tagline which functions efficiently at all boom angles and digging depths.
6. Winch Head and Third Drum attachments.
7. Convertible to Dragline, Clamshell, Shovel, Backdigger.
1. 3 axle mounting on 10 rubber tires. Both tandem rear axles drive.
2. High speed transmission range for road travel—low range for tough going off road or on job.
3. Built of standard major unit parts available all over the country.
4. Close-coupled, 175" wheelbase for better maneuvering. Steering gear designed for soft ground travel.
5. Special chassis frame design which eliminates reinforcing.
6. 10 speeds forward—and 2 reverse. Unit will climb a 30% grade.
7. Rocker arm rear end replaces springs—gives flexibility for road travel—rigidity for operation.

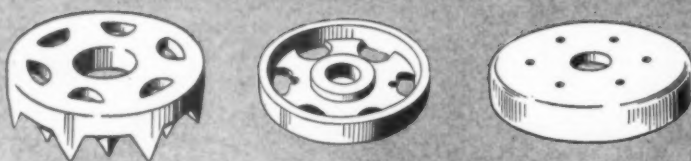
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NO JOB TOO SMALL OR SHORT—NO JOB TOO BIG OR TOUGH

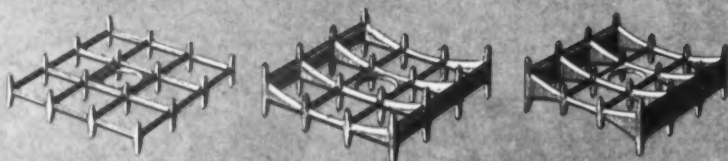
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THESE ARE THE TECO TIMBER CONNECTORS WHICH



HAVE CHANGED AN OLD CARPENTRY MATERIAL



INTO A NEW ENGINEERING MATERIAL



here's why-

This split ring TECO Connector spreads the load on a timber joint over practically the entire cross section of the wood. In bolted joints this stress is localized around the bolt.

TECO CONNECTORS
CREATE WIDE *New*
RANGE of STRUCTURAL
POSSIBILITIES IN
ECONOMICAL
Timber

These Teco Timber Connectors make low-cost timber construction applicable to a great many new types of work.

THESE ARE THE TIMBER CONNECTORS which cut costs through the elimination of over-design in timber structures . . . they do away with most of the bolts, plates and angles formerly associated with heavy construction.

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THESE ARE THE TIMBER CONNECTORS which have established a new set of engineering principles applied with conspicuous saving to nearly 30,000 CCC housing units, towers, trestles, piers, wharves, bridges, warehouses and dry docks within the last seven years.

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1337 Connecticut Avenue, Washington, D. C.

Please send us full technical information on the new design opportunities in timber made possible through the development of the TECO Connector System.

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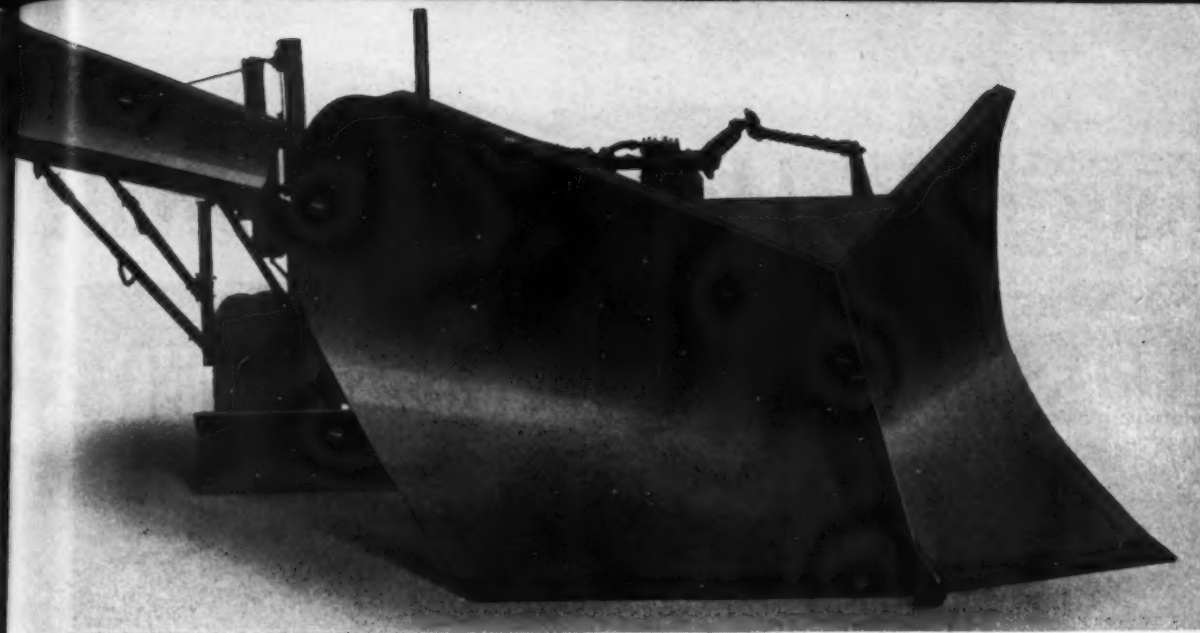
Street.....

City.....

State.....

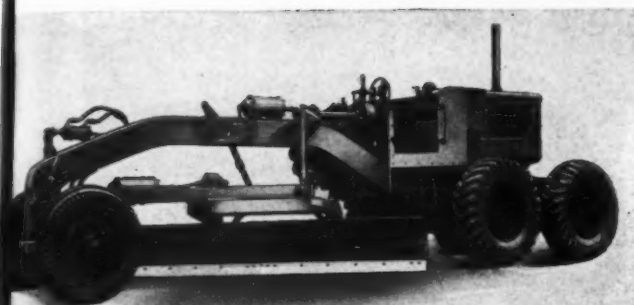
**TIMBER ENGINEERING
COMPANY, Inc.**

DEPT. S-12, 1337 CONNECTICUT AVENUE
WASHINGTON, D. C.



Galion motor grader with snow-plow attachment

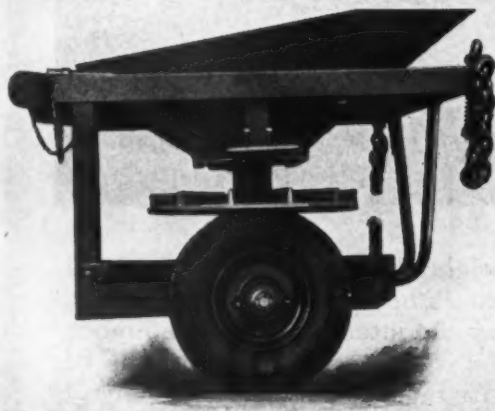
**FOR
SNOW
REMOVAL**



Above—No. 101 motor grader—diesel or gasoline—heavy duty. Below—Model 67

Three Models to Choose From—Each With Hydraulic Control

In addition to road building and maintenance, Galion Motor graders have proved highly efficient for snow removal. The snow plow attachment (above) will move great quantities of snow and where light snows are encountered the blade alone will do the job. Well braced and reinforced, attachment can be adjusted by attaching to scarifier control or can have independent control. Snow-wing attachment supplied upon request.

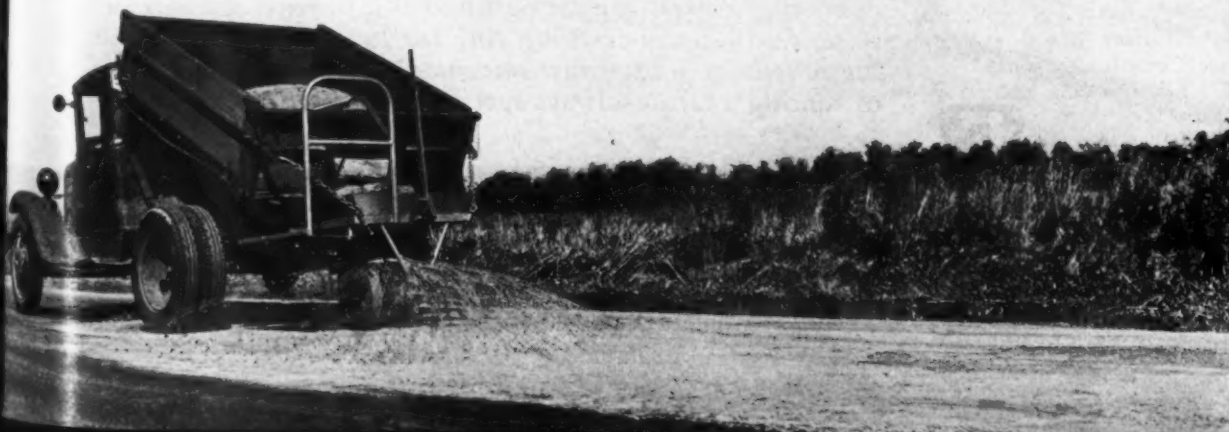


Spreads Sand, Stone Dust, Cinders, Chips, Rock Salt, Calcium Chloride

Galion highway sanders work from rear of truck with drive by friction from pneumatic tire. Distributes material ahead of rear wheels of truck as well as ahead of its own wheel—safe and sure traction. Feed continuous or intermittent. Width of spread—12 to 36 feet governed by truck speed. Two lanes covered in single trip. Two models. Send for bulletins.

The Galion Iron Works & Mfg. Co.

Main Office and Works: GALION, OHIO



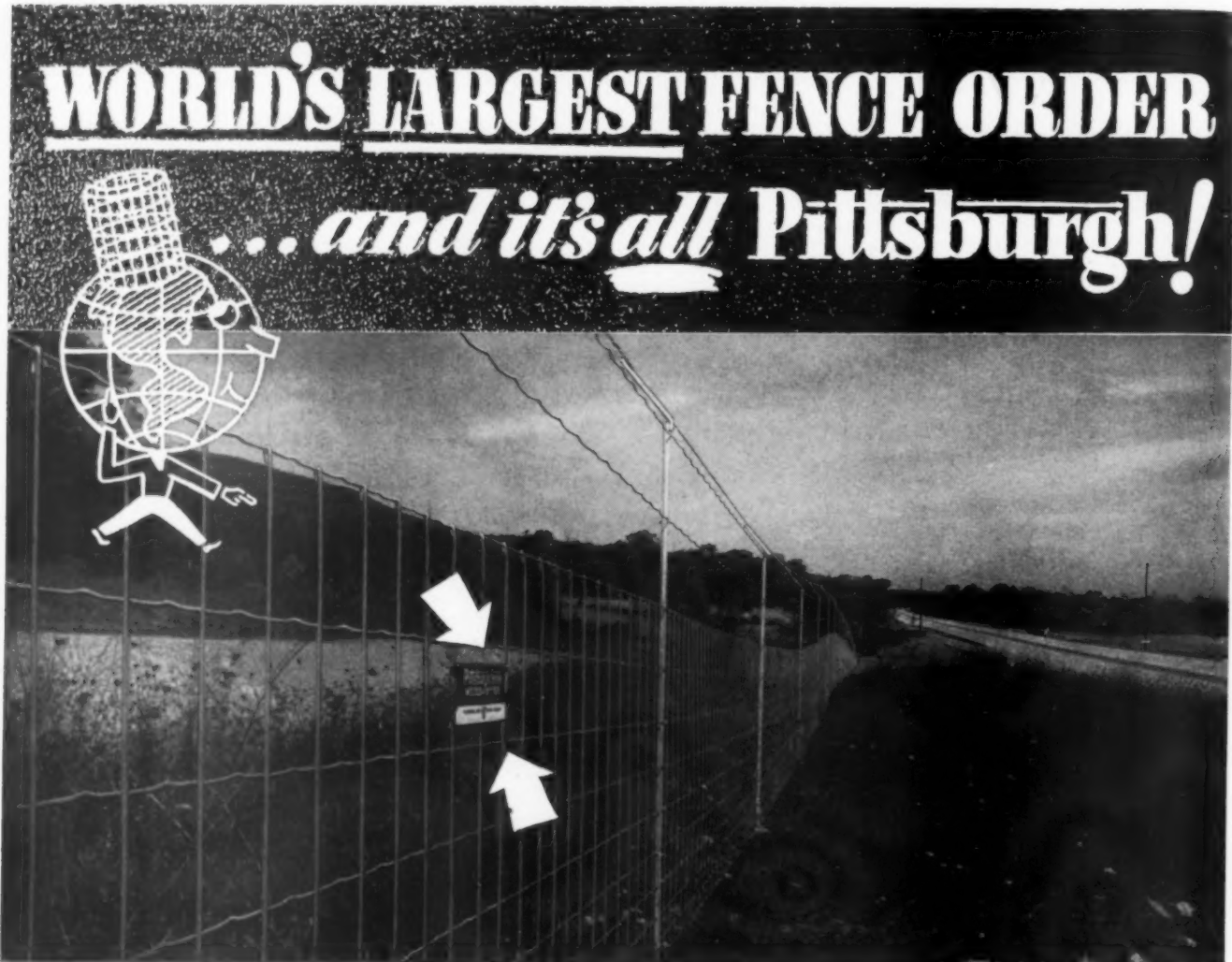
**FOR
ICY
ROADS AND
STREETS**

Galion highway sander — note width of spread

Pittsburgh Welded Wire Materials

WORLD'S LARGEST FENCE ORDER

...and it's all Pittsburgh!



ENGINEERING FACTS

Approximate combined length
of Fence 330 miles
Weight of Wire Fabric . 995 tons
Weight of Zinc Coating
on Fabric 65 tons
Weight of Posts, Gates,
Fittings, etc. 705 tons
Weight of Zinc Coating on Posts,
Gates, Fittings, etc. . 63 tons
Total weight of complete
Fence installation . 1,700 tons

More than 320 miles of bright, husky *Pittsburgh* Welded Joint Fence, and 8 miles of *Pittsburgh* Chain Link Fence, protect the *entire* right-of-way and interchanges of the famous Pennsylvania Turnpike. Yes, it's the largest single order of fence ever sold! More important, it typifies the high regard of responsible authorities for the superior qualities of *Pittsburgh*—the only fence sold under a manufacturer's Certificate of Specified Quality! *Pittsburgh's* Fence line includes Farm and Poultry Fence in hinge-joint, welded-joint and lock-joint types; Industrial Fences; Close-mesh Welded Fence Fabrics; and superb designs of Lawn Fence. All are of special analysis copper bearing steel, heavily coated with pure, ductile, non-cracking zinc for longest life. Whether for protecting a highway, safeguarding an industrial plant, or fencing a farm—always specify *Pittsburgh*!



Pittsburgh Welded Fences

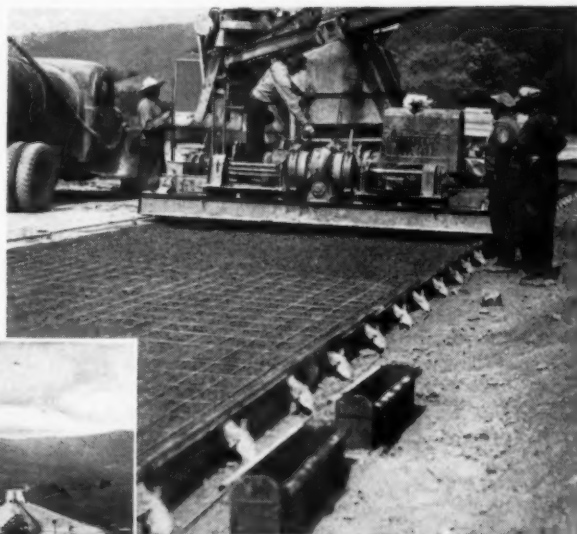
Serve Pennsylvania's new *Turnpike!*

The rugged strength and specialized construction of *Pittsburgh Welded Wire Reinforcement* for concrete roads and for concrete pipe, and *Pittsburgh Welded Joint Fence*, contribute prominently to the safety, permanence and successful functioning of the Pennsylvania Turnpike. The superiority of these three types of cold drawn, welded wire meshes result from 40 years of wire manufacturing experience and complete manufacturing control—from ore to final inspection. The use of all three for the world's most modern highway indicates the high regard of contractors, engineers and public officials alike. These and other *Pittsburgh Wire Fabrics* are available for *prompt delivery* for all phases of construction work requiring their use. Write for information and prices, now, on your present requirements.

PITTSBURGH STEEL COMPANY
1661 GRANT BUILDING • PITTSBURGH, PA.



A large part of the Reinforced Concrete Pipe used in the elaborate drainage system of the Pennsylvania Turnpike was reinforced with *Pittsburgh Welded Wire Reinforcement*. A typical drainage outlet is illustrated above. In addition, *Pittsburgh* reinforced gallery pipe was used for tunnel drainage.



Mile after mile of *Pittsburgh Reinforcing* was used in the Pennsylvania Turnpike. A concrete road in which this high tensile, welded steel mesh is imbedded is *bound* into integrated slabs of tremendous strength. It is truly *bound* to be a better road!

and Welded Wire Reinforcement

142 CLASSES OF SPECIALIZED LUBRICANTS

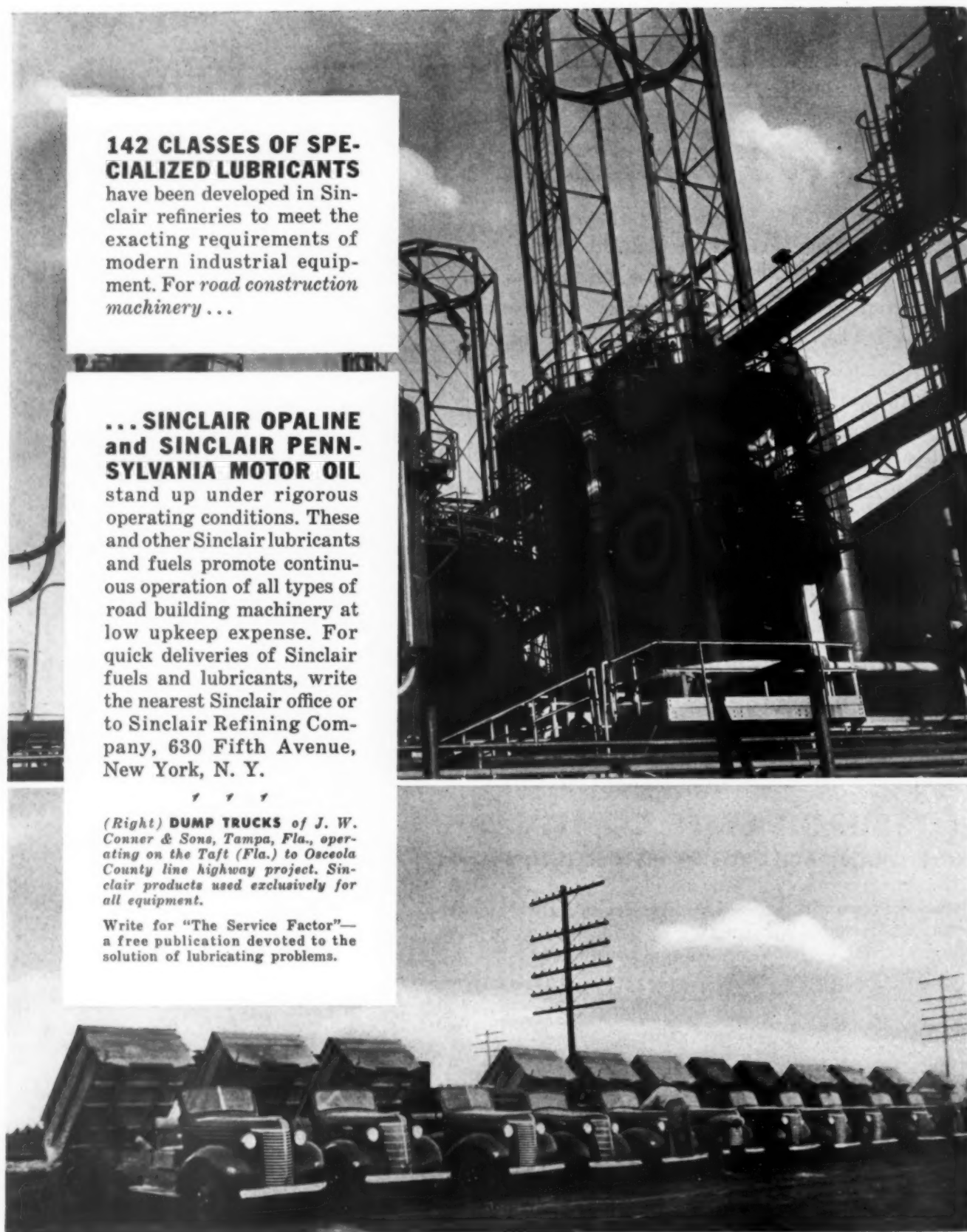
have been developed in Sinclair refineries to meet the exacting requirements of modern industrial equipment. For road construction machinery...

...SINCLAIR OPALINE and SINCLAIR PENNSYLVANIA MOTOR OIL

stand up under rigorous operating conditions. These and other Sinclair lubricants and fuels promote continuous operation of all types of road building machinery at low upkeep expense. For quick deliveries of Sinclair fuels and lubricants, write the nearest Sinclair office or to Sinclair Refining Company, 630 Fifth Avenue, New York, N. Y.

(Right) **DUMP TRUCKS** of J. W. Conner & Sons, Tampa, Fla., operating on the Taft (Fla.) to Osceola County line highway project. Sinclair products used exclusively for all equipment.

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.



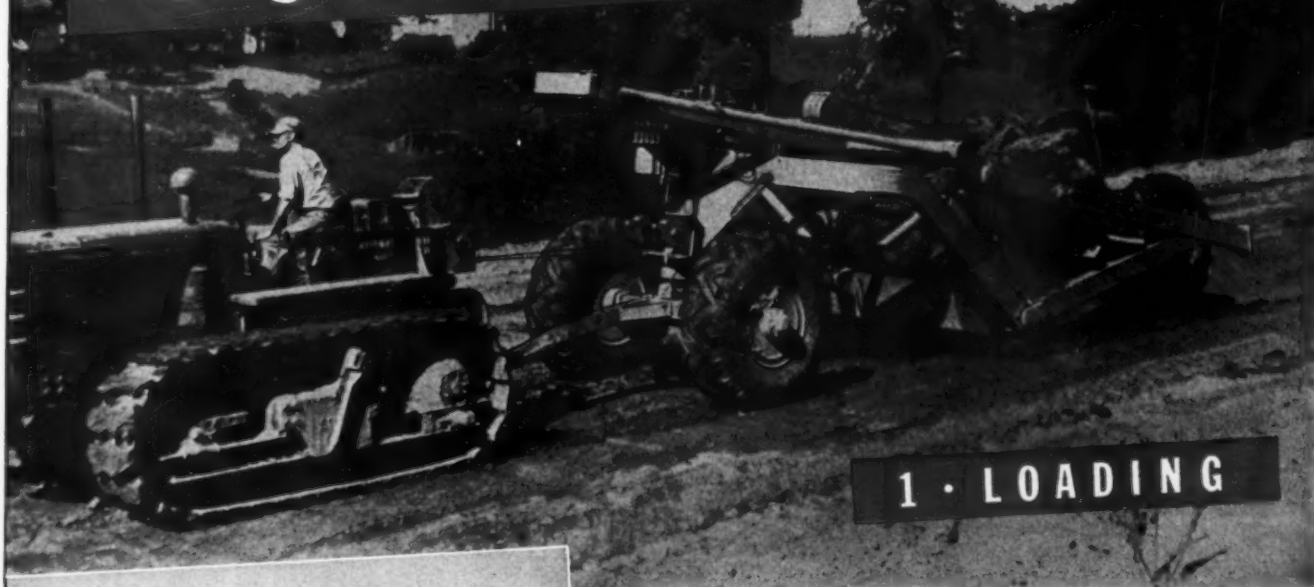
SINCLAIR LUBRICANTS-FUELS

SINCLAIR REFINING COMPANY (Inc.)

2540 W. CERMAK RD. CHICAGO • 10 W. 51ST ST. NEW YORK • 1907 GRAND AVE. KANSAS CITY • 573 W. PEACHTREE ST. ATLANTA • FAIR BUILDING, FT. WORTH

"O.K. ON ALL 3 COUNTS"

— SAY CONTRACTORS AND HIGHWAY OFFICIALS



1 • LOADING



2 • HAULING



3 • DUMPING

EVERYWHERE they go, on all types of earth-moving jobs, Adams Hauling Scrapers meet with enthusiastic approval and here's why:

THEY LOAD QUICKLY because they have a curved, drop-center bit which penetrates readily. Bowl loads well in all types of material and dirt "boils" to all parts of the bowl to get full loads with the least friction and power.

THEY HAUL EASIER because the load is equally distributed over four extra-large, low-pressure tires which float easily over soft ground. Draft is lighter; faster travel speeds and more trips per day are possible.

THEY DUMP OR SPREAD FASTER because bowl tilts to steep dumping angle and dirt does not stick or pack in Adams bowls as in narrow, deep bowls. Material can be spread uniformly to any desired thickness—usually at hauling speeds.

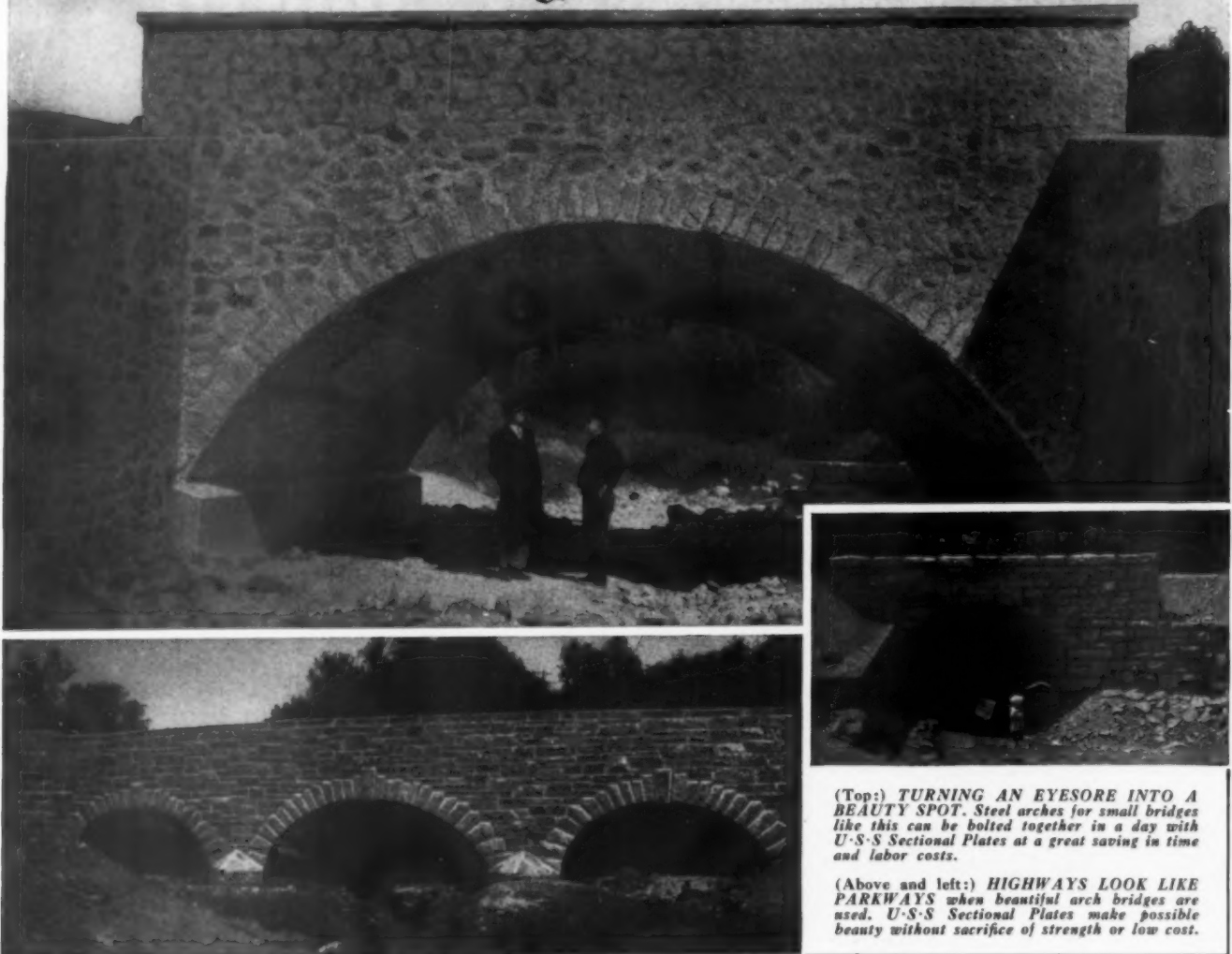
Adams Hauling Scrapers are available in 3¼, 5¼, and 11¼ yard sizes. See your local Adams representative for a demonstration on your job or write

J. D. ADAMS COMPANY, INDIANAPOLIS, INDIANA

*Branches, Representatives & Distributors
throughout United States*

ADAMS Hauling Scrapers

Build Beauty INTO SMALL BRIDGES



(Top:) *TURNING AN EYESORE INTO A BEAUTY SPOT.* Steel arches for small bridges like this can be bolted together in a day with U·S·S Sectional Plates at a great saving in time and labor costs.

(Above and left:) *HIGHWAYS LOOK LIKE PARKWAYS* when beautiful arch bridges are used. U·S·S Sectional Plates make possible beauty without sacrifice of strength or low cost.

*... and build faster, stronger,
cheaper with U·S·S Sectional Plates*

THERE'S no reason why small bridges should not be beautiful when they are so easy to build with U·S·S Sectional Plates. Graceful arches can be quickly bolted together by ordinary labor crews.

Expensive forms are not required. U·S·S Sectional Plates fit together firmly. The base metal is U·S·S Copper Steel, which has double resistance to atmospheric corrosion. In addition, a heavy coating of galvanizing is ap-

plied to furnish extra protection against rust.

The adaptability of U·S·S Sectional Plates makes them suitable for culverts, sewers, conduits, or the enclosing of small streams.

Write to any of the companies listed below for complete information on how to save time and money with this new type of construction.



SECTIONAL PLATES

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*

COLUMBIA STEEL COMPANY, *San Francisco*

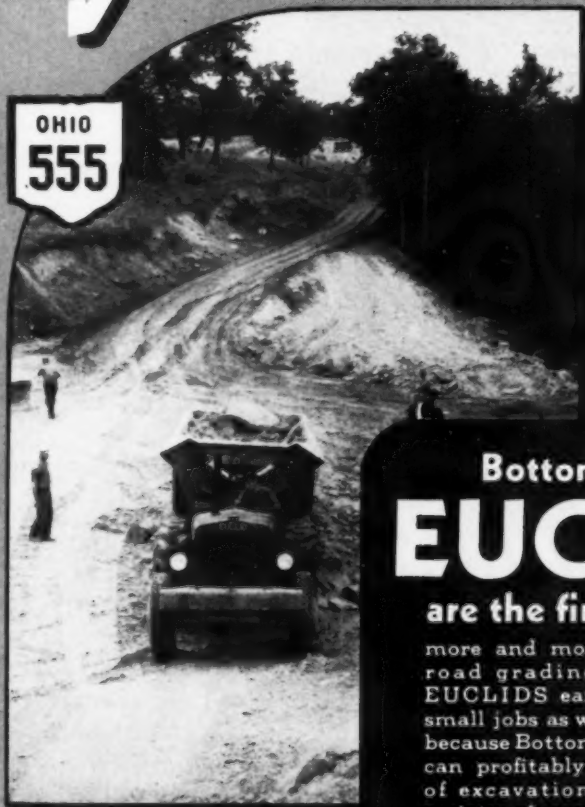
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*

Scully Steel Products Company, *Chicago, Warehouse Distributors*

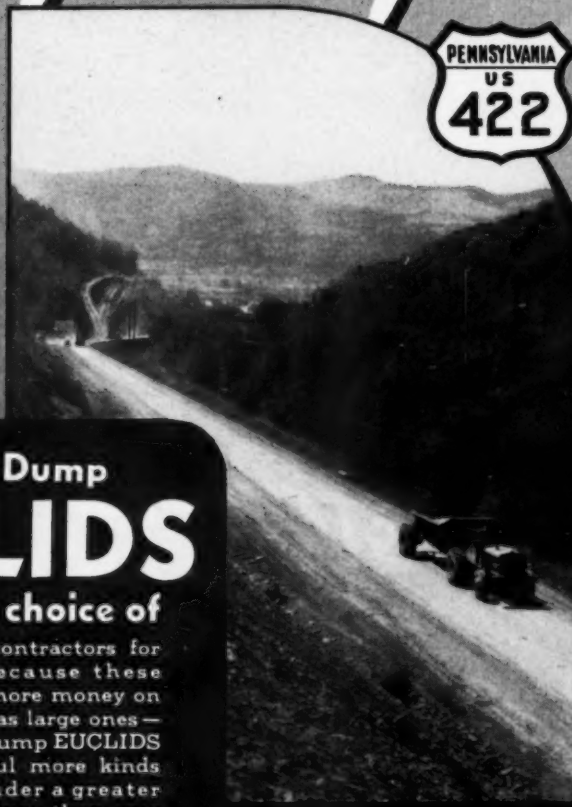
United States Steel Export Company, *New York*

UNITED STATES STEEL

For road grading...



W. P. McCarren
Zanesville, Ohio



Ralph Myers Construction Co.
Kittanning, Penna.

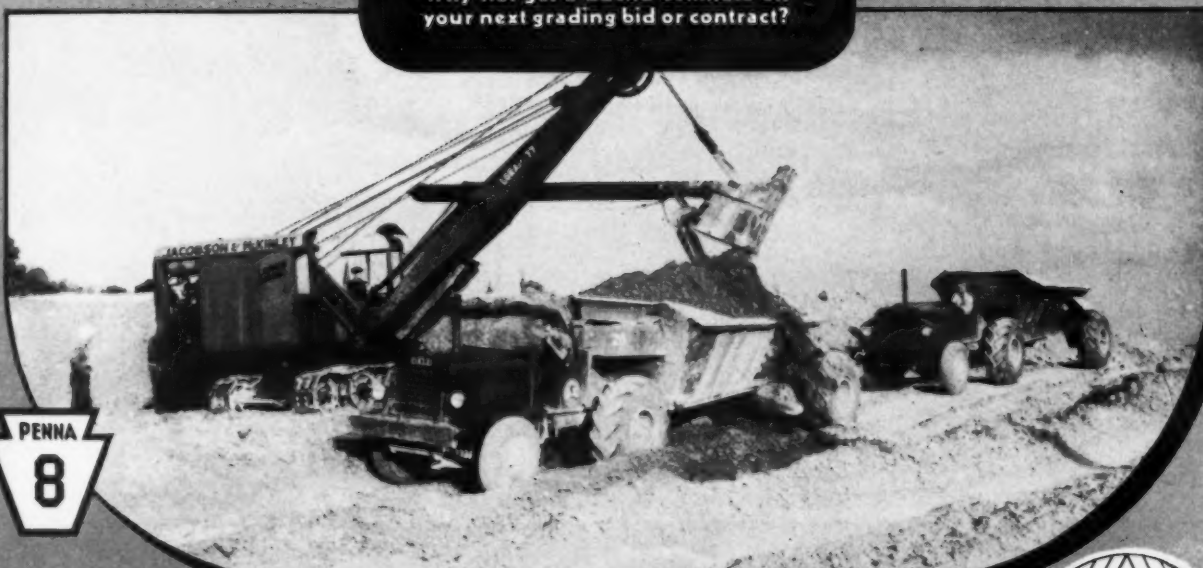
Bottom-Dump EUCLIDS

are the first choice of

more and more contractors for road grading because these EUCLIDS earn more money on small jobs as well as large ones — because Bottom-Dump EUCLIDS can profitably haul more kinds of excavation under a greater variety of conditions than any other equipment.

★ ★ ★


Why not get a Euclid estimate on your next grading bid or contract?



Geo. M. Brewster & Sons, Inc., Butler, Penna.


THE EUCLID ROAD MACHINERY CO.
CLEVELAND, OHIO U. S. A.





*There will be no
sudden one-way
Bottle-necks on
this Highway*

SN  GO



No banks will be left to catch drifting snow and cause costly *repeat plowing*.

No shoulders will be covered with snow to influence uneven sub-grade temperatures that result in heaving.

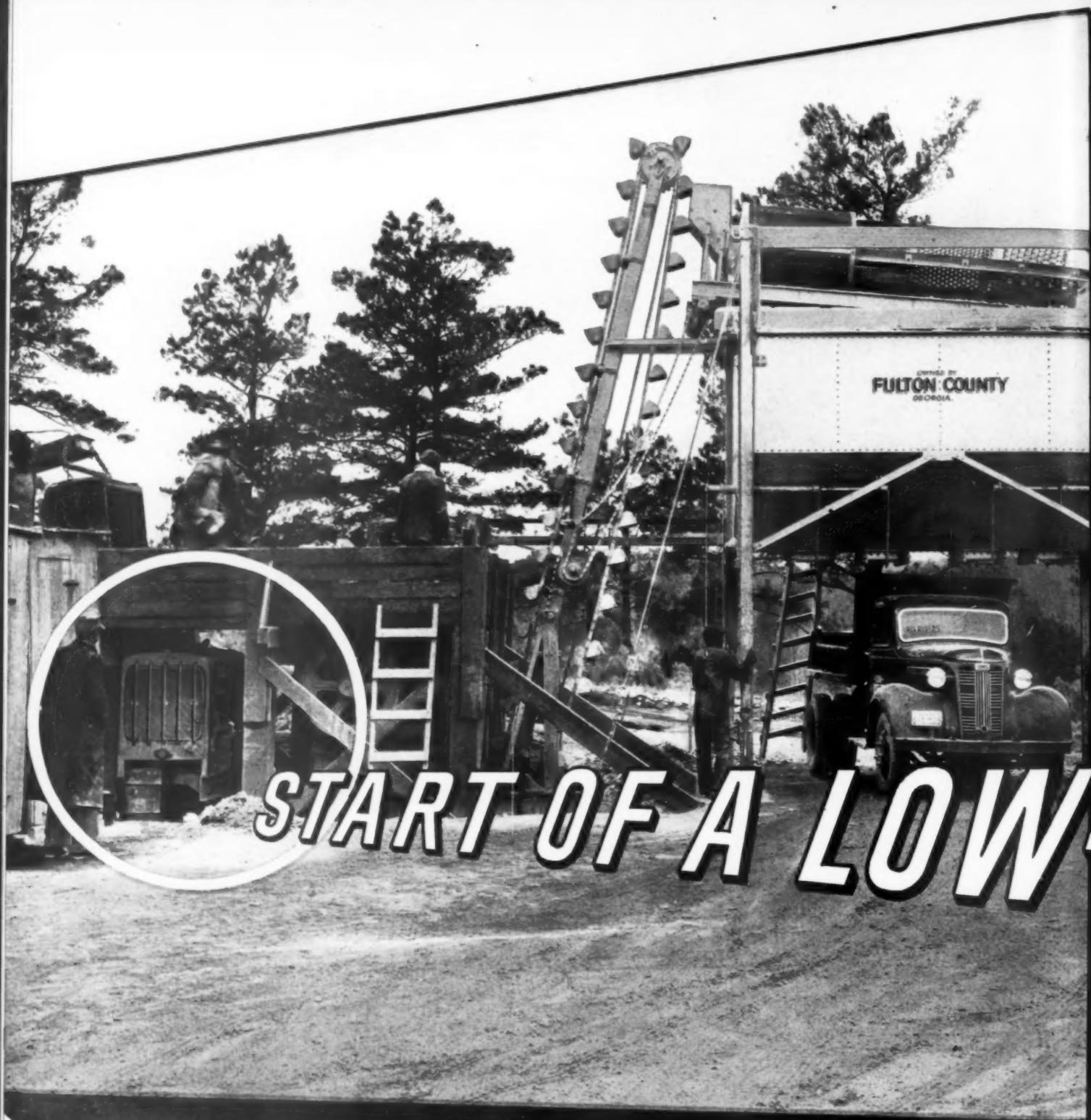
There will be no excess seepage to undermine road and shoulders — ditches will function normally.

There will be no thick snow layers to thaw and freeze into dangerous ice blankets. Snogo gets right down to the grade.

**THERE IS A
SNOGO
FOR EVERY
BUDGET—**

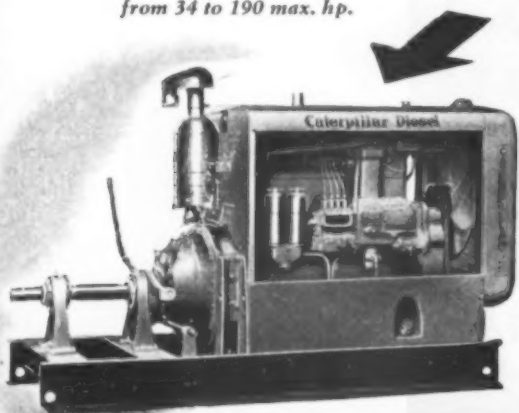
**FROM A 1½ TON TO
THE LARGEST FOUR
WHEEL DRIVE TYPE
OF TRUCK**

**KLAUER
MANUFACTURING COMPANY
Dubuque Iowa**



START OF A LOW-C

• Model view of the new
"Caterpillar" Diesel D8800
Engine. "Caterpillar" Diesel
Engines are available in sizes
from 34 to 190 max. hp.



CATERPILLAR

REG. U.S. PAT. OFF.

DIESEL

ENGINES AND ELECTRIC SETS
TRACK-TYPE TRACTORS • ROAD MACHINERY



The cost of building or maintaining a road is affected even in remote factors: In planning the work as well as in executing it . . . in preparing the materials needed as well as in laying them . . . in choosing equipment as well as in operating it.

What about your crushed-rock and gravel costs? What about that vitally important factor, *power*? Is it anywhere nearly as economical as the power which the "Caterpillar" Diesel Engine pictured at the left is furnishing for the alert and far-seeing highway department of Fulton County, Georgia?

This D8800 drives a 60-ton Cedar Rapids crusher

producing 150 yards of road-bed rock per 8-hour day, while using only 3 gallons of 8c fuel per hour. Steam, the former power, had been costing *twice as much*.

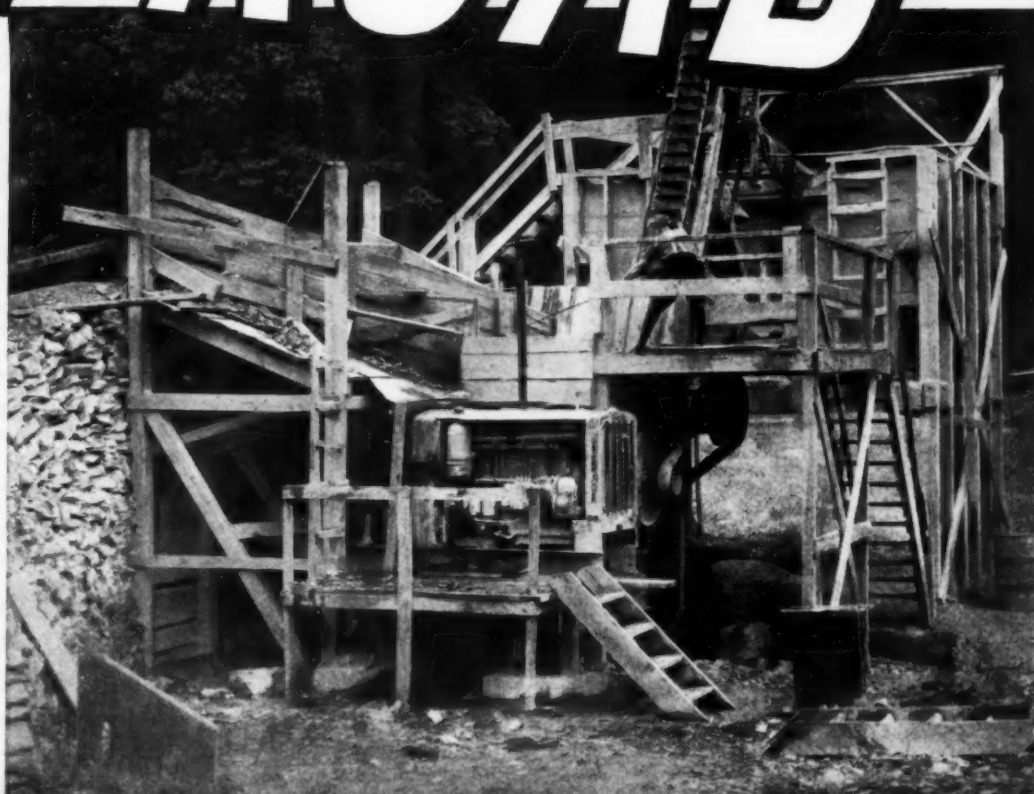
A typical but not unusual instance. Yet, from coast to coast similar savings are being reported on state, county, municipal and contractor-owned "Caterpillar" Diesels. Installations are increasing at a rapid rate. For the reputation of these rugged, compact, dependable and readily portable power-plants grows greater and greater as the months and years add to their records of long-life performance and truly worth-while operating economy.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

COST ROAD

• Here is another typical county-owned gravel plant. It is powered by a "Caterpillar" Diesel D7700 Engine. Owned by Randolph County (Illinois) Highway Department.

• Leading manufacturers of shovels, cranes, dredges, crushers, compressors power their products with "Caterpillar" Diesel Engines. Insist on "Caterpillar" Diesel Power for your equipment.



Roads and Streets

Owen Buckets

The OWEN BUCKET Co. 6070 BREAKWATER AVE. CLEVELAND, OHIO

BRANCHES: New York, Philadelphia, Chicago, Berkeley, Calif.

Labels on buckets: GENERAL PURPOSE, MATERIAL HANDLING, HEAVY DUTY, EXTRA HEAVY DUTY, EXTRA HEAVY ROUND NOSE, A MOUTHFUL AT EVERY BITE, A TYPE FOR EVERY PURPOSE

Corrugated STEEL SHEET PILING

CAN BE USED TO ADVANTAGE ON ANY OF THESE JOBS...

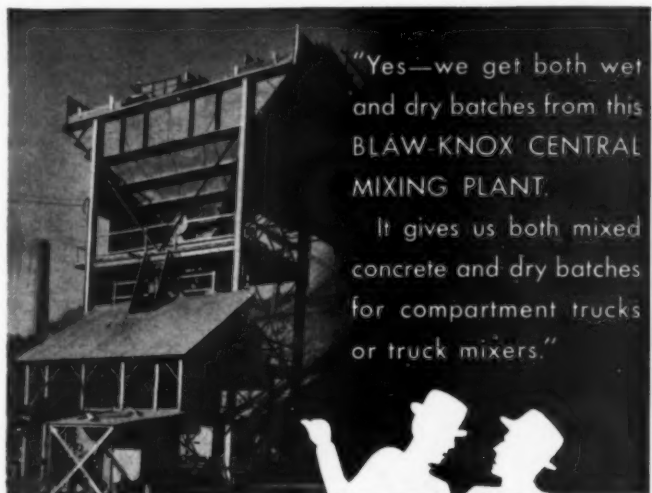
SEWERS
SEWAGE DISPOSAL PLANTS
FILTRATION PLANTS
COFFERDAMS
FOUNDATION EXCAVATIONS
DAMS
LEVEES
BULKHEADS
CUT-OFF WALLS
LOCKS
BRIDGES

... **because** it is light weight for fast, economical handling; yet possesses a tensile strength of about 45,000 lbs. per square inch; can be driven speedily by hand or light power equipment; makes possible a watertight construction; and, in many cases, may be re-used over and over.

Union Metal Corrugated Piling is offered in 8, 10 and 12 gauge in lengths up to 30 ft. Write today for complete product information.



THE UNION METAL MFG. CO.
CANTON, OHIO



"Yes—we get both wet and dry batches from this BLAW-KNOX CENTRAL MIXING PLANT.

It gives us both mixed concrete and dry batches for compartment trucks or truck mixers."

No matter how varied and involved the concrete requirements on your job might be—Blaw-Knox will design a Central Mixing Plant to solve your problems economically.

Stationary or floating plants, manual or automatic in operation, have been furnished for hundreds of jobs. See them in Catalog No. 1566.

14

BLAW-KNOX BLAW-KNOX DIVISION
OF BLAW-KNOX CO.
Farmers Bank Bldg. Pittsburgh, Pa.

CENTRAL MIXING PLANTS

Photo by
Courtesy
of the
Sterling
Motor Truck
Co.

A COMPARATIVE JOY RIDE



EXPERIENCE *builds them*

THE Harrison Construction Co. of Pittsburgh finds the speedy movement of this monster Lorain shovel on their Trailer a joy ride in comparison with older methods or less advanced equipment.

ROGERS' TRAILER

This completely electrically welded trailer is thoroughly engineered to withstand every possible strain including terrific overhanging loads like this one.

Four rear axles oscillate longitudinally and transversely to distribute the load over sixteen tires and Patented equalizing brakes afford safety of control under all conditions.

There is a Rogers trailer for every requirement.

ROGERS BROTHERS CORPORATION
110 Orchard St. Albion, Penna.

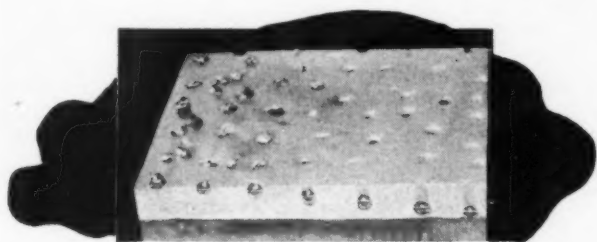
PERFORMANCE *sells them*



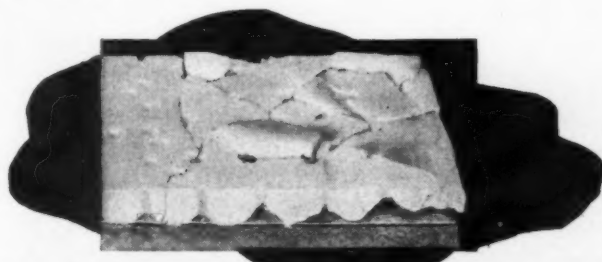
INTERNATIONAL "Auger Action" ROCK SALT

How it helps in keeping roads and streets clear
of ice and snow in winter—at utmost low cost!

BELOW is a photographic reproduction of an accurate model showing Rock Salt's "Auger Action." This shows how Rock Salt works to remove hardpacked snow or ice. Many street and road officials have known of Rock Salt's powerful ice melting power for years.

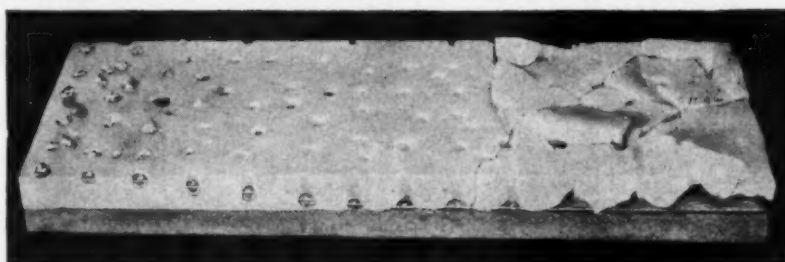


"Anti-skid" Rock Salt crystals are an abrasive themselves. Spread on hardpacked snow or ice, International's "Auger Action" Rock Salt imbeds itself at once, to provide an "anti-skid" surface immediately.



"Ice Breaks Up" Ice when riddled with holes and undercut, soon breaks up. Any passing traffic speeds up the breaking process. Small bits of ice, loosened from the pavement, can be easily scraped aside, plowed away, or removed to leave the pavement completely bare and really safe.

"Auger Action" Crystals of Rock Salt bore through the icy covering as a carpenter's auger bores through wood. As it melts through the ice, brine is formed which undercuts the ice and loosens its bond with the pavement.



They have used Rock Salt with abrasives—and have seen how the Rock Salt melts snow and ice to help in its removal.

Today, an increasing number of street and road officials use International's Rock Salt straight, without abrasives, to keep city streets and long stretches of open highway, free and clear of ice and hardpacked snow all winter long. It is simple and easy. Rock Salt is spread at the start of a storm. Often this is enough to melt away all snow. In every case, it prevents the snow from packing, from forming ice and bonding to the pavement. If ice has formed, Rock Salt's "Auger Action" quickly bores through and undercuts it so that it can easily be scraped aside, plowed away or removed.

City and road officials alike now know that this method of using "Auger Action" Rock Salt straight provides a far higher degree of safety at a far lower cost. It reduces the number of men required. It saves in the cost of machinery. It is the one ice melting agent practical for complete snow and ice removal, because Rock Salt will melt two to three times as much ice per dollar, as any other available ice melting agent. For information about this proven, effective way of keeping streets and roads clear for utmost traffic safety, write for the folder, "Rock Salt's Auger Action."

INTERNATIONAL SALT COMPANY
INCORPORATED
Scranton, Pennsylvania

A YARD AND A HALF
that's a
 MACHINE AND A HALF



Investigate the Bucyrus-Erie 37-B when you need an excavator that combines the speed necessary for big output with the toughness required to take heavy digging in its stride. Ask about the performance the 37-B has delivered on all kinds of jobs all over the world. Find out

how oil-enclosed gears, anti-friction bearings, direct-action control, accessibility of machinery, and other Bucyrus-Erie features mean extra money for you. Study the 37-B and you'll agree it's the finest machine of size on the market. Don't take our word for it; find out for yourself.

Bucyrus-Erie

S O U T H M I L W A U K E E , W I S C O N S I N



● Regardless of the machine or job—shovel, crane, hoist, scraper, elevator, whatnot—Hazard LAY-SET Preformed will give you the same amazing resistance to fatigue, the same uniformly long life—because Hazard LAY-SET is “at ease.” The preforming process at the mill relieves the rope of locked up stresses; leaves it flexible, easy to handle, willing to work. Hazard LAY-SET Preformed is so calm, so thoroughly “at ease,” that it has almost no tendency to kink, it resists whipping or rotating in sheave grooves, it spools better. More than this Hazard LAY-SET Preformed is a safer rope to handle. Being “at ease” broken crown wires do not spring out to tear workmen’s hands and possibly cause blood-poisoning. For your next rope specify Hazard LAY-SET Preformed and be “at ease” yourself about its greater dollar value.

HAZARD WIRE ROPE DIVISION • WILKES-BARRE, PENNSYLVANIA

Established 1846

District Offices: New York, Chicago, Philadelphia, Pittsburgh,
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AMERICAN CHAIN & CABLE COMPANY, Inc.



Keep construction moving



WITH BETHLEHEM ROAD STEELS

MEN, machines and materials must combine to form a smoothly flowing production unit when you're building a modern highway. That's why road building contractors have learned that it pays to take advantage of the Bethlehem Road Steel Service that permits ordering all road steel requirements from one dependable source.

Bethlehem Road Steel Service helps you keep road construction moving smoothly and economically in a number of ways. Bethlehem Road Steels come to you ready for installation with minimum time and trouble. Bethlehem Road Joints, for instance, are shipped as complete units with dowel caps fitted in position. Another advantage is that when you place your order with Bethlehem, one of the fifteen Bethlehem warehouses or a jobber near you swings into prompt action. Combining all your road steel requirements, from highway guards to reinforcing bars, in a single order for Bethlehem



products offers you another benefit, because you eliminate needless bookkeeping, phone calls or correspondence.

Investigate these advantages of Bethlehem Road Steel Service now. A letter to Bethlehem Steel Company, Bethlehem, Pa., will bring you full details.

BETHLEHEM STEEL COMPANY



SPEEDING UP U. S. NAVY AIRPORT CONSTRUCTION



HERE one mile equals fifteen. This Normal Duty Barber-Greene Mixer is mixing sand asphalt for runways over 300 feet wide and 6" thick. There's a big job to be done, and the Barber-Greene is doing it with speed, economy, and perfection. Rated at $1\frac{1}{4}$ to $1\frac{3}{4}$ yards per minute in the B-G Catalog, this Normal Duty Model 848 is consistently mixing 3 cubic yards per minute of loose material on this job, not only speeding up construction, but meeting rigid Navy inspection.

Its ability to handle any bituminous or stabilizing job, in either Travel or Central Plant operation, its portability, high capacity, and thoroughly earned reputation for accurate proportioning and thorough mixing deserve your investigation. The B-G Mixer Book explains and illustrates its many outstanding features. Write for your copy. There is no obligation.

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BARBER GREENE
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Announcing

A NEW COMPANION TO THE FAST-MOVING STANDARD C TOURNAPULL

THE SUPER C TOURNAPULL

With MORE POWER—
125 & 150 H. P.—and
GREATER CAPACITY
—15 Heaped Yards for
your LONG HAULS.



LESS than six months ago we announced the Standard C Tournapull (90 H.P.) with LS Carryall Scraper (11 heaped yards). Alert contractors the country over bought one and two for trial, quickly found them to be the fastest, cheapest method of long-haul earthmoving on the market, soon became fleet users.

FOR MORE YARDAGE PER HOUR

Profitable as the Standard C has proved, many contractors have asked us for a Tournapull of similar size but with more power and greater capacity for use on jobs demanding still more yardage per unit per hour. Our answer is the Super C Tournapull, powered by either a 125 or 150 H.P. Diesel engine, to handle an LP Carryall Scraper with 15 heaped yards capacity.

SAME PROFITABLE SPEED

Like the fast-moving, job-proved Standard C, the bigger-powered

Super C Tournapull utilizes the power of a "Caterpillar" D8 pusher unit to cut loading time and heap on capacity Carryall loads in a hurry. It attains high-gear hauling speed quickly, spreads its load on the fill without stopping and high-balls back to the cut for another load—all in one continuous operating cycle. No need for special spreading equipment on the fill . . . no waiting in line at a shovel . . . thus you further increase earthmoving efficiency, cut costs and earn more profit on larger long-haul jobs. Try the Super C Tournapull. See for yourself . . . NOW . . . what it can do for you.

SPECIFICATIONS IN BRIEF

	Standard C	Super C
Horsepower	90	125 or 150
Shipping Weight . . .	25,300 lbs.	30,500 lbs.
Carryall Model	LS	LP
Heaped Capacity . . .	11.2 yds.	15 yds.
Struck Capacity	8.2 cu. yds.	12.1 cu. yds.

Ask your LeTourneau—"Caterpillar" dealer to demonstrate . . . or write Dept. RS for more details.

SUPER C TOURNAPULL is Completely Equipped — No Extras to buy.

Standard equipment on the Super C Tournapull includes brakes on both Tournapull and LP Carryall Scraper; front crankcase guard with front pull hook and bumper; electric lights*, starter*, and horn*; operator's cab; Carryall pusher block*. There are no extras to buy—your first price includes everything.

*Also standard equipment on Standard C Tournapull—brakes, guard and cab optional at slight extra cost.



Part of Cavanaugh Construction Company's fleet of four 90 h.p. Standard C Tournapulls with LeTourneau LS Carryall Scrapers (11 heaped yards) handling the long-haul earthmoving on Carey Dam, near Carey, Idaho.

(Below) 150 h.p. Super C Tournapull, with LP Carryall Scraper (15 heaping yards capacity), designed for pusher loading to get capacity yardage fast.



LETOURNEAU

PEORIA, ILLINOIS • STOCKTON, CALIFORNIA

CARRYALL* SCRAPERS, ANGLEDZERS*, BULLDOZERS, ROOTERS*, POWER CONTROL UNITS, DRAG SCRAPERS, CRANES, PUSHDOZERS, SHEEP'S FOOT ROLLERS, TOURNAPULLS*, TOURNATRAILERS*.

*Name Reg. U. S. Pat. Off.

"That's a Handsome Structure, Tim —Looks Rugged and Durable Too"



With all its good looks, an ARMCO Multi Plate Bridge is built to do a "he-man's" job. Year after year you can depend on it to stand up under heavy traffic with no time out for upkeep or repairs.

The use of ARMCO Multi Plate permits an almost unlimited variation in size and design. An average installation is quickly erected. Unskilled men do the work handily, using only simple tools. And back-

filling can be started as soon as the units are assembled. Multi Plate structures need no costly curing to assure safe strength.

Once in place, ARMCO Multi Plate meets every requirement of a sound bridge structure. Heavy gage plates with extra-large corrugations provide ample strength to meet highway loading specifications with a wide margin of safety. Durability is assured by a base metal of galvan-

ized ARMCO Ingot Iron—proved in 34 years of corrosive service.

Let us explain how easy and economical it is to obtain beauty and utility with ARMCO Multi Plate Pipe or Arches. Our experienced engineers will be glad to cooperate with you in applying Multi Plate to specific applications. Just write us what you have in mind. ARMCO DRAINAGE PRODUCTS ASSOCIATION, 5078 Curtis St., Middletown, Ohio.

ARMCO



MULTI PLATE PIPE AND ARCHES

A TYPE OF PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

MOVING A RAILROAD



Part of the fleet of 12 Koehring Wheelers hauling dirt at high speed.



Koehring Excavators, used for excavating, handling forms and material.

Twelve Koehring Wheelers on the Santa Fe main line track re-location project — to make way for Caddoa Dam . . . hauled dirt night and day at high speeds over long hauls. Speed was essential to hold the cost down . . . and the Koehring Wheeler Method was the profit answer. • Fast loading, high speed travel, loaded or empty, complete, quick dumping, short turning radius, are the second-saving features that reduce the cost of dirt-moving, when the Koehring Wheeler Method is used. Koehring Excavators handled material, forms and excavation on this 3,500,000 yard project.



KOEHRING COMPANY • Milwaukee, Wis.

HEAVY-DUTY CONSTRUCTION EQUIPMENT

Come and get the Answers!

- What does military transport do to roads?
- A new field for the contractor—the airport!
- Super highways—the big jobs of the future!
- What about new things in Snow and Ice Control?
- Your bidding problems—what are they?
- The legal angle on contracting—things you need to know!
- How shall we redesign intersections?
- Why develop the interregional roads?
- How do taxes affect your profits?
- Traffic—how to analyze it!

These subjects are close to your pocketbook — men who have found the answers are going to tell you about them — give you a chance to discuss them — ask questions! Here's the year's opportunity to get real help on the things that are bothering you most. *Note the date — plan now to come!*

ROADS for DEFENSE

—MOTION PICTURES
—INSPECTION TRIPS
—OPEN DISCUSSION
—EXCHANGE OF
EXPERIENCES
—FUN!

38th ANNUAL
CONVENTION
PENNSYLVANIA HOTEL
NEW YORK CITY
JAN. 27-31, 1941

AMERICAN ROAD BUILDERS ASS'N.
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MY ADVICE IS ... USE EXCELLAY!

FROM THE DAILY REPORT OF A TIGER BRAND WIRE ROPE ENGINEER

I was just walking into Mr. Brown's office when one of his engineers called this morning.

"My advice to you," he said on the phone, "is use Excellay. No other rope can touch it. Next time the Tiger Brand Engineer comes in I'll have him see you. He's helped me out dozens of times."

Then he looked up and saw me. "Well," he said, "speak of the devil and there he is." The three of us went over the specifications together, and decided that Brown was right — Excellay will do the best all-round job.

Yours,

Jim



KNOWING wire rope from A to Z—how to choose it and how to use it—that's the job of the American Tiger Brand Wire Rope Engineers. It will pay you to make use of their specialized knowledge and experience, gained through years of practical service to wire rope users in every industry, everywhere.

These men do more than help you select the right rope for a given application. If for any reason you are not

getting full performance, they can help you locate the trouble and suggest practical ways and means for eliminating the difficulty. Get to know the American Tiger Brand Wire Rope Engineer who contacts you. Discuss your wire rope problems with him. Get his advice on every wire rope specification.

He can help you get a full dollar's worth of performance out of every dollar you invest in wire rope.



EXCELLAY

Preformed

WIRE ROPE



AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY

San Francisco

United States Steel Export Company, New York

UNITED STATES STEEL



"The job's the place to judge a Tractor!"

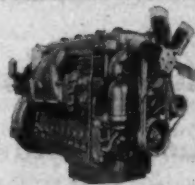
"I've been out here all morning—and believe me, I've learned something about tractor performance.

"First thing, when the skimmers walked out to start the shift they just climbed aboard those HD-14's, kicked the starter and rolled off to the cut. No cranking, no warming up, no greasing—they were getting loads three minutes after the shift started!

"And power...! that 2-cycle powerhouse they've got in there really has a punch. They work at least one gear higher all the time—haul and backhaul in 6th gear even on upgrades. They can dump at the same speed as they haul, and the skimmer just *throttles* down for turns—never touches the gears! Those HD-14's are turning in two or more extra trips every hour!

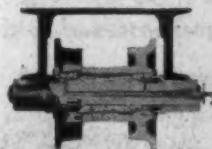
"That tractor gets to work quicker, works faster and gets more done than any rig I ever saw!"

SMOOTH 2-CYCLE DIESEL POWER!



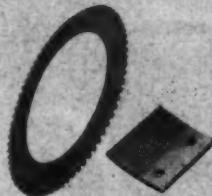
Delivering power every down stroke of the pistons, this compact engine delivers smooth "steam engine" power that *hangs on*—delivers maximum torque from 1400 right down to 800 r.p.m.! Uses standard Diesel fuels; delivers 95% of its full rated power at 6000 ft. altitude!

POSITIVE SEAL TRUCK WHEELS AND IDLERS!



There's a 200-hour supply of lubricant in these truck wheels and idlers... Instead of greasing every shift, you lubricate only once every 20 shifts. Saves you about 200 lbs. of grease and 10 hours of working time every 200 hours on the job!

BI-METALLIC CLUTCH AND BRAKE LININGS!



Here's an all-metal friction surface that gives you velvet-touch control *plus* long life. It conducts heat away from friction surfaces fast, wears slowly and has high mechanical strength.

COMPLETELY EQUIPPED... NO EXTRAS TO BUY!

Standard Equipment includes electric starter and lights, muffler, radiator guard, crank-case guard, front pull hook, bumper, hour-meter, radiator shutters, fenders and heavy truck wheel guards. It's a complete tractor, ready to go to work... on your job NOW.

ALLIS-CHALMERS POWER

IT DOESN'T
COST..
it Pays!



"The Greatest Name in Trucks"

INTERNATIONAL makes the Trucks . . . Truck Owners make the REPUTATION

The *reputation* enjoyed by International Trucks has been building steadfastly since the first high-wheeler took to the rough roads of 1907—33 years ago.

Today, *International* is the *greatest name*

in trucks because Harvester has kept faith with the men who use trucks.

All International Trucks are *all-truck* trucks from the ground up—backed always by the world's greatest Company-owned truck service organization!

Year after year truckmen buy *more heavy-duty Internationals than any other make*. They know that Internationals give them *outstanding performance . . . unbeatable economy*.

For all-around *truck values*, join the big family of International owners. The International Dealer or Company-owned Branch near you will be glad to demonstrate the type and size best suited for your business.

INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago, Illinois



Here is the new heavy-duty International Cab-Over-Engine Model DR-500, carrying capacity of 12,000 lbs.—a typical example of how International designs trucks for every hauling need. This is one of 51 models in the complete International line.

INTERNATIONAL TRUCKS

ROADS and STREETS

Vol. 83, No. 12

December, 1940

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ESTABLISHED 1906

Methods of Arriving at

TOTAL DEPTHS OF SUBBASE, BASE AND SURFACING

For Ballasting Subgrade Soils for Stability

By JOHN O. IZATT

*Project Engineer, Materials Division
Idaho Bureau of Highways*

IN IDAHO the stabilization of subgrade soils to provide for adequate wheel-load support and substantial year-around performance consists primarily of covering them up or ballasting over with acceptable granular materials. This practice is as old as highway construction in the state. Numerous sources of water-deposited gravels and sands, as well as rock quarries, readily accessible in practically all sections of the state have contributed to making this practice feasible and effective.

Heretofore the matter of quality of the ballast and the amounts or depths to which it was used were largely a matter decided by the engineer located on his particular job. As a result, good A-2 soils were often treated with more ballast than the poorer A-5 or A-7 types in another part of the state. Also, projects transversing both good and bad soils were often constructed with a uniform depth of granular materials over their entire length. The engineers responsible had little except previous experience and observation to guide them in the use of this costly material, and obviously it was not always used to the best advantage.

With the advent of our soils surveys and soils profiles in 1938-1939, engineers were confused in their efforts to interpret such soils characteristics as capillarity, elasticity, cohesion, and compressibility in a way which would afford some positive or practical application of this knowledge to design and construction. Their principal concerns were: What quality of ballast shall I provide, and how much? Naturally, they turned to soils analysis to answer these questions.

The Idaho Materials Laboratory now furnishes the designing engineer with the following test results on all samples of soils analyzed: (1) Grading of the original sample and complete Atterberg constants on the minus 40 fraction, which include liquid limit, plastic limit, plasticity index, shrinkage limit, shrinkage ratio, field

moisture equivalent, centrifuge moisture equivalent and volumetric change, (2) Rose lineal shrinkage, (3) California "bearing and expansion test" on all granular materials; i. e., materials having more than 35 per cent retained on a No. 200 sieve. This test is based upon the resistance of a compressed specimen to the penetration of a piston when tested in both a dry and a saturated state, and to the per cent of swell of the specimen when immersed in water. (4) "Proctor" compaction data—optimum moisture, plasticity at optimum moisture, and maximum dry weights of the soil.

Soils Evaluation Information

For the purpose of predetermining the depth of ballast necessary over a given soil identified according to the above test procedures, various authorities have made up empirical tables based upon test sections, observation, and experience. Idaho makes use of five of these tables, and while they are not entirely consistent, they afford the best approach of any for our purpose. These tables are tempered with consideration for such items as: (1) past performance of the soils when previously used in construction, (2) type of granular material available, (3) traffic data, (4) drainage notes, and (5) probable funds available. A list of these tables and the source and/or author of each is given at the end of this article.

After completion of the soils tests and the soils profile, the Materials Division forwards to the designing engineer what is called an evaluation sheet on which the soils are evaluated in terms of required granular ballast. On this sheet is listed the following pertinent information: (1) the highway station at which the sample was taken, (2) the materials laboratory identification number, (3) the soil layer number, and (4) the Public Roads Administration classification; i. e., A-2, A-3, etc. To these pertinent details are added and recorded the total depths of ballast as interpreted from Tables I, II, III

and V, together with the A.A.S.H.O. rating from Table IV. Next is shown the *total depths of subbase, base and surfacing recommended by the materials laboratory and the recommended gradings and types of these materials* to furnish adequate stability and durability.

The consideration of providing a "blanket course" or "choker course" over a soil and beneath an open-graded base material is determined on the basis of lineal shrinkage, volumetric change, and the minus 200 fraction. The dividing line for these values comes at a lineal shrinkage of 5 per cent and/or a volumetric change of 17 per cent with 35 per cent passing the No. 200 sieve. If soils show values equal to or greater than these values, they are judged to contain an active clay fraction which will result in the absorption of an open-graded subbase by the subgrade or vice versa. The above rule cannot be rigidly adhered to, but serves as a guide.

The evaluation is furnished the designing engineer in full appreciation of the fact that we still have no accurate method of determining the exact depths of acceptable ballast required for stability over any given soil, but are using information available to narrow the limits within which "guesswork" must function.

Laboratory recommendations for ballast are based upon the assumption that all embankments will be properly constructed with layer construction and compaction to acceptable densities. No ordinary amount of ballasting can save an improperly constructed embankment from failure.

Design Procedures Illustrated

The following are step-by-step illustrations of how the recommended depths are arrived at, using the tables and laboratory test data as noted.

Example No. I.—Laboratory test results on this sample of soil were as follows:

MECHANICAL ANALYSIS	
Size of Sieve Opening	Per Cent Total Pass
3 in. sq.	100
1 in. sq.	88
¾ in. sq.	86
½ in. sq.	79
¼ in. sq.	68
No. 10	54
No. 20	43
No. 40	33
No. 60	24
No. 140	15
No. 200	13

SOILS CONSTANTS	
Liquid limit	25.5 per cent
Plastic limit	Non-plastic
Field moist. equiv.	25.6 per cent
Lineal shrinkage	2.8
Specific gravity	2.68
Soil Classification: Granular material	

BEARING VALUES (CALIFORNIA)	
(Specimen compacted with 2,000 pounds per square inch load)	
Soaked	81.6 per cent
Unsoaked	54.9 per cent
Swell	0.5 per cent

This material is granular and preference is given to Table No. II, the California charts. With a bearing value of 54.9 per cent, which is the lower of the two values, and a swell value of 0.5 per cent, we enter the chart and read the requirements: a *wearing course* only. This value is noted on the evaluation sheet. Next we check by use of Table No. I. Entering the chart with a liquid

limit of 25.5 per cent, a plastic index value of N.P., and a minus 200 value of 13, we place this granular soil in the "Excellent B" group and read the requirements of 0 inches to 6 inches total ballast. This figure is noted also. Next, we consider Table No. III and enter the chart to read a requirement of 6 inches total. Likewise, this value is noted. No maximum dry weight on Proctor analysis was made, since this material is granular, so Table No. IV, the A.A.S.H.O. rating, is passed. Now we group the material in the broad rating of "Good" from the "Subgrade and Embankment Soils" Table, No. V. We read a recommended minimum of 6 inches total surfacing. So far all tables are comparatively in agreement. This is not always true.

Getting into the contingent items, nothing is known of past performance of this material, so this item is passed. Traffic is recorded for this particular project on the traffic flow maps as 110. We add a plus thereby (110+) and record the figure. There are no acute drainage problems and we assume standard construction for drainage. Thus far, the choice will have to be somewhere within 0 inches to 6 inches, with a preference for a wearing course only, as required by Table No. II. Here data collected thus far are to be overshadowed by a construction problem. Due to the coarse oversize and the construction problems involved, a base course of less than 4 inches is never advocated for use over a new grade. This base course plus a future 2-inch oil mat satisfies the requirements of all the soil constants and contingencies of which we are aware. The evaluation is reported as 4 inches minimum with a future oil mat. In the final analysis, the practicality of construction methods was the deciding factor.

Example No. II.—Laboratory test results on the soil sample as furnished the designing engineer are as follows:

SOIL GRADING	
Sieve or Particle Size	Per Cent of Total
Gravel—Ret. on 10 mesh.....	0
Coarse sand—Pass 10 mesh, ret. 40 mesh.....	3
Fine sand—Pass 40 mesh, ret. 270 mesh.....	12
Silt—.05 mm to .005 mm.....	63
Clay—Smaller than .005 mm.....	22
Colloids—Smaller than .001 mm.....	8

MECHANICAL ANALYSIS	
Size of Sieve Opening	Per Cent Total Pass
¾ in. sq.	100
No. 10	100
No. 20	99
No. 40	97
No. 60	95
No. 140	93
No. 200	91

SOIL CONSTANTS	
Liquid limit	27.4 per cent
Plastic limit	24.4 per cent
Plastic index	3.0
Shrinkage limit	20.7 per cent
Shrinkage ratio	1.61
Field moist. equiv.	27.6 per cent
Cent. moist. equiv.	22.7 per cent
Volumetric change	11.1 per cent
Lineal shrinkage	3.8 per cent
Specific gravity	2.69
Soil Classification: A-4	

PROCTOR DATA	
Optimum moisture	20.2 per cent
Plasticity (O.M.)	400 lb./sq. in.
Max. Dry Wt.	103.4 lb./cu. ft.

This soil is a non-granular A-4, and a preference is given to Table No. I. With a value of liquid limit of 27.4, a plastic index value of 3.0, a minus 200 portion of 91 per cent, and a classification of A-4, we read from the table, 9 inches to 18 inches and we further note that the soils constants are very low for a soil in this group. The soil is one of the better A-4's. Table No. II is passed up since we have no bearing value on a non-granular material. Table No. III gives us a value of 6 inches plus. Table No. IV rates the soil on the low side of the "Poor" group. Table V rates the soil in the "Fair" group, requiring 9 inches minimum of surfacing or form 6 inches to 12 inches of select borrow with 6 inches \pm of surfacing.

Drainage is average and traffic is listed at 225+. For lack of information, "past performance" is skipped. This soil has a lineal shrinkage of only 3.8 and a volumetric change of 11.1. From these constants, assumptions are made that detrimental shrinkage and expansive properties are not present, and no "blanket" course is recommended. Ten inches total subbase, base and surfacing are recommended. Here our decision was based fundamentally upon the low constants for the 9 inches to 18 inches group of Table I and the comparably low traffic count.

Example No. III.—Laboratory test results as reported to the designing engineer on this soil sample were as follows:

SOIL GRADING

Sieve or Particle Size	Per Cent of Total
Gravel—Ret. on 10 mesh	0
Coarse sand—Pass 10 mesh, ret. 40 mesh.....	0
Fine sand—Pass 40 mesh, 270 mesh.....	1
Silt—.05 mm to .005 mm.....	46
Clay—Smaller than .005 mm.....	53
Colloids—Smaller than .001 mm.....	24

MECHANICAL ANALYSIS

Size of Opening	Per Cent of Total
No. 40	100
No. 60	100
No. 140	99
No. 200	99

* Waterlogged.

SOIL CONSTANTS

Liquid limit	52.5 per cent
Plastic limit	24.5 per cent
Plastic index	28.0
Shrinkage limit	17.2 per cent
Shrinkage ratio	1.77

Field moist. equiv.	31.4 per cent
Cent. moist. equiv.	*60.9 per cent
Volumetric change	25.1 per cent
Lineal shrinkage	8.8 per cent
Specific gravity	2.69
Soil Classification: A-6-7	

PROCTOR DATA

Optimum moisture	24.8 per cent
Plasticity (O. M.).....	425 lb./sq. in.
Max. Dry Wt.	97.0 lb./cu. ft.

This is a non-granular A-6-7 and Table No. I will again be given preference. Entering this table with a liquid limit value of 52.5, a plastic index of 28.0, and a minus 200 fraction of 99 per cent, we find the soil fits most nearly into the "B" side of the 12 inches to 24 inches group. The constants are about average for this group. Again, Table II can not be considered. We pass to Table No. III and read a value of 12 inches total minimum. Little weight is given to this table or to the more recent Arizona table requiring 15 inches plus. Table No. IV rates the soil as "very poor." Table V places the soil in the poor group, requiring 12 inches minimum of crushed surfacing or 12 inches to 18 inches of select material plus a surfacing of 6 inches \pm . Ordinarily we consider increases in 3-inch increments for values over 12 inches. In so doing, we arrive at an approximate average minimum of 18 inches total. Next we pass on to the traffic count and find the road is one of the heaviest traveled in the state, with a vehicle count of 800+. This encourages more ballast if future stability is to be considered. A return glance at the soils constants shows a centrifuge moisture equivalent of 60.9 per cent, "waterlogged." This shows that in time even a well-constructed subgrade will become saturated and that side drainage will be of little avail for the center of the road. Bad frost heaving in future years can be considered very probable. In order to assure stability against this heaving, a thickness of ballast deep enough to get below the frost line is considered the only positive corrective measure. Previous information on this project shows the country traversed to be irrigated, and subwater table to be higher than the bottom of the present borrow ditch. The lineal shrinkage and volumetric change values indicate the necessity of a subgrade blanket. One is recommended.

This combination of undesirable soils constants and adverse drainage conditions, heavy traffic, low unit dry weight, lead us to the suggested 21 inches minimum total depth of ballast.

Soils Evaluation Tables

TABLE I

DISTRICT NO. 2 USPRA, TABLE OF RECOMMENDED DEPTHS OF SELECTED MATERIALS FOR STABILIZATION. (RESULTS OF TEST SECTION AND OBSERVATION)

Mechanical Analysis of Total Sample	Excellent		Good				Fair		Poor	
	A	B	A	B	C	D	A	B	A	B
Per cent passing No. 10.....	25—65	25—65								
Per cent passing No. 40.....	10—50	10—50								
Per cent passing No. 200.....	25—	15—	15—	15—	35—	35+	35—	35+	35—	35+
Liquid Limit	25—	35—	35—	35+	35—	25—	35—	50—	35—	50+
Plasticity Index	6—	6—	15—	6—	10—	6—	30—	20—	30+	20+
Group	A 1, 2, 3		A 2, 3, 4, 5				A 2, 4, 5, 6, 7		A 5, 6, 7	
Thickness of subbase base and surfacing.....	0 in. to 6 in. Ave. 3 in.		2 in. to 8 in. Ave. 6 in.				9 in. to 18 in. Ave. 12 in.		12 in. to 24 in. Ave. 18 in.	

TABLE II

CALIFORNIA METHOD OF SURFACE STABILIZATION BASED ON BEARING AND SWELL VALUES OF SUBGRADE SOILS AS DEVELOPED BY TESTS AND EXPERIENCE

Subgrade Bearing Value Lb. per Sq. In. for Penetration of 0.1 In.	Expansion Per Cent	Total Thickness in Inches of Selected Subgrade Material and Surfacing
800 = (81% approximate)	3 maximum	3
500 = (51% approximate)	3 maximum	4
300 = (31% approximate)	3 maximum	5
200 = (20% approximate)	3 maximum	6
100 = (10% approximate)	No limit set	9
60 = (6% approximate)	No limit set	12
50 = (5% approximate)	No limit set	15
30 = (3% approximate)	No limit set	18

(Idaho reports per cent of standard which value is for all practical purposes the same as per cents shown above.)

TABLE III (a)

ARIZONA METHOD OF BASE STABILIZATION BASED UPON THE LINEAL SHRINKAGE VALUES OF THE SUBGRADE SOILS

Lineal Shrinkage	Total Thickness of Subbase, Base and Surface
0 per cent — 2 per cent	Wearing course only
2 per cent — 4 per cent	6 in. total
4 per cent — 6 per cent	8 in. total
6 per cent — 9 per cent	12 in. total
9 per cent +	15 in. +, but not to exceed 24 in. total

NOTE: Arizona has more recently prepared a new table based on lineal shrinkage, centrifuge moisture equivalent, plastic index, and grading, about as follows:

Conclusion

In conclusion, the Materials Laboratory makes many uses of the results of soils testing and soils surveys by applying the results to initial roadway alignment, selective placement of soils, and compaction control, but primarily, as stated, in the ballasting of soils. The above evaluation practices have not been in use long enough to predict, accurately, the results, but because they are fitted to our condition and are in line with two decades of highway construction, they offer us a plausible solution to intelligent design and construction until they eventually are replaced by better methods.

Design and testing are under the direct supervision of C. P. Humphrey, Director of Highways, and C. Clifford Hallvik, Materials Engineer for the Idaho Department of Public Works.

TABLE III (b)

BASE COURSE THICKNESS REQUIRED FOR VARIOUS SUBGRADES AND PROPERTIES OF BASE COURSE MATERIALS

	—40M Lineal Shrink Per Cent	CME Per Cent	Plastic Index Per Cent	Mat'l Ret. on No. 3 Sieve Per Cent	Mat'l Pass No. 200 Sieve Per Cent	Thickness Base Course Required Inches
Subgrade	—3	—18	—6	10+	—20	0 to 6
Subgrade	—5		—12	10+	—30	6 to 9
Subgrade	—7		—15		—40	9 to 12
Subgrade	—9		—20		—45	12 to 15
Subgrade	9+		20+		45+	15+*

* Subgrades of this type should not be used in fills in new construction.

TABLE IV

EMBANKMENTS UNDER 10 FT. IN HEIGHT PLACED ON LEVEL FOUNDATIONS AND SUBJECT TO MINOR FLOODING

Dry Wt. Peaks Lb./Cu. Ft.	Approximate Public Roads Administration Classification	Rating	Suggested Min. Field Com. Req'ments Per Cent of Dry Wt. Peak	Suggested Side Slope Design
90.00 and below	A-5, A-8	Unsatisfactory		1 on 2
90.0 — 100.00	A-5, A-8	Very Poor	95	1 on 2
100.00 — 110.0	A-6, A-7	Poor	95	1 on 2
110.0 — 120.0	A-4	Fair	90	1 on 1½
120.0 — 130.0	A-3, A-2	Good	90	1 on 1½
130.0 and above	A-1	Excellent	90	1 on 1½

EMBANKMENTS UNDER 10 FT. IN HEIGHT PLACED ON SLOPING FOUNDATIONS AND SUBJECT TO MAJOR FLOODING

Dry Wt. Peaks lb./cu. ft.	Approximate Public Roads Administration Classification	Rating	Suggested Min. Field Com. Req'ments Per Cent of Dry Wt. Peak	Suggested Side Slope Design
95.0 and below.....	A-5, A-8	Unsatisfactory		
95.0 — 110.0	A-6, -7	Very Poor	100	1 on 2½
110.0 — 120.0	A-4	Poor	95	1 on 2
120.0 — 130.0	A-3, A-2	Fair	90	1 on 1½
130.0 and above.....	A-1	Good	90	1 on 1½

TABLE V

SUBGRADE AND EMBANKMENT SOILS TABLE

CONDENSED SOIL RATINGS AND DESIRABLE THICKNESSES OF SELECTED SUBGRADE MATERIAL

Condensed Ratings	Good*	Fair*	Poor
Groups (See Soil Identification Charts).....	A-1, A-2, A-3 A-2-4 None or	A-4, A-2-5 A-2-6, A-2-7	A-5, A-6 A-7
Thicknesses of Selected Material under adequate surfacing (6"±).....	6 in.**	6 in. to 12 in.	12 in. to 18 in.
Minimum Surfacing Thicknesses if Selected Material not placed.....	6 in. min.	9 in. min.	12 in. min.

* A-2-5, A-2-6 and A-2-7 soils having less than 15 per cent passing No. 200 sieve may be rated as "Good".

** Even though tests indicate "Good" ratings for soils in proposed excavation, a more uniform subgrade may be obtained by constructing the top 6 in. of subgrade with the best material available from selected cuts or borrow pits. Where undergraded rock cuts are involved thicknesses may be 9 in. rather than 6 in.

INSPECTORS OF SUPPLIES NEEDED FOR WAR DEPARTMENT

The United States Civil Service Commission is endeavoring to secure inspectors of miscellaneous supplies to fill positions at the Jeffersonville Quartermaster Depot, Jeffersonville, Indiana.

Inspectors are needed in the following classes of supplies: Hardware, leather, wood products, china and glassware, stoves and ranges, tents, sheet metals and sheet-metal products, bakery and cafeteria equipment, tableware and kitchen utensils, paints, varnishes, shellac, lacquers, etc., and gasolines, greases, lubricating oils, etc. The salary for these positions ranges from \$1,800 to \$2,000 a year, less a retirement deduction of 3½ per cent.

Applications may be filed with the Secretary, Board of U. S. Civil Service Examiners, U. S. Engineer Department at Large and Jeffersonville Quartermaster Depot, Louisville, Kentucky, until further notice. In view of the great demand for qualified persons, applicants are urged to file their applications promptly.

Applicants must have completed a 4-year high-school course, except that they may substitute additional inspectional or testing experience for this requirement. In addition, they must have had 4 years of experience in the inspection or testing of one or more of the classes of supplies listed above. Each year of college study in appropriate engineering courses may be substituted for each 6 months of this experience. Applicants will not be given a written test, but will be rated on their qualifications as shown in their applications and on corroborative evidence.

Further information regarding the examination may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at the post office or customhouse in any city which has a post office of the first- or second-class, or from the United States Civil Service Commission, Washington, D. C.

CALL FOR MORE PROCUREMENT INSPECTORS

More procurement inspectors are needed at the Air Corps, Wright Field, Dayton, Ohio, for the following branches of inspection: Aircraft, engines, instruments, parachutes, aircraft propellers, and tools and gages.

The Civil Service Commission has been seeking experienced men for these jobs but it announces that a new type of position has just been added to those to

be filled—that of Junior Procurement Inspector, \$1,620 a year. The upper grades pay from \$2,000 to \$2,600 a year. (All salaries are subject to a 3½ per cent deduction for retirement annuity.)

For the junior grade, college graduation in engineering may be substituted for experience as follows: Graduates in aeronautical engineering will be eligible for *aircraft, engines, instruments, and propellers*; graduates in mechanical engineering will be eligible for *engines, instruments, and tools and gages*; graduates in electrical engineering will be eligible for *instruments*.

For the upper grades, mechanical experience, which may include apprenticeship, is required in the branch applied for except that the experience on *engines, instruments, and tools and gages* need not have been in aircraft work. In fact, for *engines*, mechanical experience on construction or machining of engines or as a machinist or toolmaker working to close tolerances using precision instruments or measuring devices will be acceptable. College courses in engineering may be substituted for a part of the experience of the upper grades.

Applicants will not be given a written test. They will be rated on their education and experience as shown in their applications, subject to verification by the Commission.

This work is an important part of the National defense program. Apply for details to the Secretary, Board of U. S. Civil Service Examiners, Wright Field, Dayton, Ohio; to any first- or second-class post office; to the U. S. Civil Service Commission, Washington, D. C., or to any of the Commission's district offices.

COLORADO HIGHWAY CONFERENCE

The University of Colorado will hold its Fifteenth Highway Engineering Conference on the campus in Boulder on January 9 and 10, 1941. Major emphasis will be placed on soils and road foundations, compaction of fills, design trends, land use and zoning, simplified highway specifications and defense aspects of highways.

Walter H. Klapproth of La Grange, Ill., former traffic engineer of the Illinois highway commission, was appointed Dallas traffic engineer by City Manager James W. Aston.

MODERN HIGHWAY COST ACCOUNTING

By F. A. FLANAGAN

Engineer Cost Accountant,
Kansas State Highway Commission

UNTIL recently a majority of highway departments have given little thought towards an adequate cost accounting system, having concentrated their efforts on the construction of a state system of highways and its maintenance. They have been satisfied merely with a monthly statement of receipts and disbursements.

Highway departments today are being confronted today with questions of operating costs and finance that a simple system of receipts and disbursements will not provide the answers. For example: Departments are acquiring a multitude of various types of equipment for construction and maintenance work, the cost of which should no longer be charged directly to one job because of the fact that this modern equipment is being moved from one job to another, therefore means must be provided to distribute equitably these costs.

In a great many states it is becoming necessary to reconstruct or relocate many of the earlier constructed roads, due to failure or obsolescence. This reconstruction work will soon begin to consume a large portion of highway income and in order to forecast the amount of money that will be required annually to pay for this reconstruction, it becomes necessary to set up highway investment and highway depreciation ledgers that will provide the facts necessary in planning a balanced highway program that will take care of, not only new construction and maintenance, but insure the renewal of those roads already in use.

The American Association of State Highway Officials, through its Committee on Uniform Highway Accounting, has provided the impetus for the improvement and expansion of cost accounting in highway departments and the work of the Statewide Highway Planning Survey has shown the importance of knowing the value and the replacement costs of our highway systems.

Equipment Cost Accounting

A uniform system of cost accounting for State Highway Departments should include an adequate equipment cost accounting section, one which will furnish reliable information on the cost of operating various types of equipment and provide an accurate means of distributing these costs to the numerous activities of the department. It is recognized that the detail for distribution of equipment operating cost may be carried to extremes, resulting in a system which becomes so complicated in its operation that it loses its economic value.

The initial cost or purchase price of the equipment is extremely important in arriving at the operating costs since it forms a basis for the determination of depreciation rates. The initial cost should consist of the purchase price including all delivery charges and other costs of assembling or servicing the equipment at the time of delivery. Trade-in allowances on new equipment should be considered the same as a cash payment and in no case used to reduce the initial cost of the equipment purchased. Accessories or other additions to the equipment made after the initial purchase should be added to the initial cost of the equipment rather than being charged directly to the functions of the department.

Equipment manufactured by the department should be considered in the same light as if purchased outright and the manufacturing cost, including labor, materials and overhead charges, should constitute the initial cost of that equipment.

All equipment has a definite asset value throughout its span of usefulness and it is therefore desirable that the initial cost be set up in the equipment accounts for each unit of major equipment, see figure 1, and for classes or groups of minor equipment that are subject

EQUIPMENT RECORD

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Fig. 1.—Equipment Record Card. Actual Size is 10 in. by 5 in. On the Reverse Side is a "Tire Record" with the Following Headings: Position, Size; No. Plies; Make; Type; Serial No.; On—Date, Miles, Hours; Off—Date, Miles, Hours; Total Miles or Hours Used. A Card is Used for Each Major Unit of Equipment

[illegible]

Fig. 2.—Equipment Operating Cost Record Card. Size is 10 in. by 5 in. This Card is Partial Record of Fig. 1. Both Sides of Card Have Same Heading

to depreciation. Small tools worn out within a year may be charged direct to expense at the time of purchase.

Equipment operating costs are generally considered to be fuel, lubricating oil and grease, while equipment maintenance costs cover minor repairs, tires, tubes, major overhauling and other miscellaneous charges.

Daily or periodic reports covering the operating cost of all motorized or heavy duty road equipment should be submitted by the operators or secured from other sources in order that the actual cost of operation of the equipment may be known. These operating costs should be reconciled to fiscal accounts covering expenditures for the operation and maintenance of equipment.

There are certain indirect costs charged to equipment operation and they generally include repair shop overhead, servicing and storage not chargeable directly to an individual piece of equipment. The cost of fire, theft, liability and property damage insurance should, also, be included in indirect costs.

Depreciation may be defined as the more or less gradual exhaustion of a physical asset value due to wear and tear, obsolescence or inadequacy. All equipment owned and operated by a highway department is merely incidental to the function of highway construction and maintenance, the same as labor, materials and supplies. Due to the fact that the life of highway equipment extends over a long period of time and because of the relatively high initial cost, equitable distribution cannot be made by charging the initial cost direct to projects or functions. The generally approved method for distribution of this initial cost is through a regular periodic depreciation charge. Depreciation rates and methods are best determined from previous experience with necessary adjustments to meet varying conditions. The primary object being that of equitably distributing the initial cost to the various functions of the department.

The preceding paragraphs have dealt with the cost of owning, operating and maintaining equipment. Having determined as accurately as possible these costs, it is necessary to provide a means of distributing them to the numerous projects and functions of the highway department. There are various methods now in use, some of which are entirely satisfactory and others par-

tially so. The principle motive is to see that all of the above costs are equitably distributed. The method of setting up one equipment charge rate to cover all equipment costs appears to be preferable because of the reduction in the number of items to be distributed and the ease of obtaining reasonable and equitable distribution. This charge should be applied to passenger cars and trucks on a mileage basis and on other road equipment on an hourly basis; on some types of equipment a monthly basis may be found most satisfactory.

Regardless of the method of accruing equipment costs or the manner used in distributing such cost, it is extremely important that these costs be definitely reconciled with the fiscal control records. Equipment purchases, maintenance and operating cost that cannot be reconciled to actual expenditures are of doubtful value.

The Highway Accounting Department's general ledger should provide sufficient asset accounts to record the value of the equipment and related assets. The following general ledger control accounts are suggested:

Highway Equipment	Small Tools
Shop Equipment	Land for Buildings
Office Equipment	Buildings
Engineering Equipment	Highway Patrol Equipment
Laboratory and Testing Equip- ment	Stores
	Radio Equipment

The following minimum list of equipment cost accounts should, also, be included:

Equipment Operating Costs	Indirect Costs (Overhead)
Equipment Maintenance Costs	Depreciation Expense

The general ledger expense accounts should provide for depreciation expense on various classes of equipment. Generally these depreciation expense accounts should parallel the equipment asset accounts. As depreciation is charged against the various kinds of work in the department and recorded in the depreciation expense accounts, a like amount should, of course, be set up in the depreciation reserve accounts. These depreciation reserve accounts, also, should be similar to the equipment asset accounts.

Wherever a charge rate is used, whether it covers merely depreciation or includes all charges of operating,

STATE HIGHWAY COMMISSION OF KANSAS HIGHWAY DEPRECIATION LEDGER

[illegible]

Fig. 4a.—Left Half of Annual Depreciation Sheet for Determining Annual Depreciation and Valuation of Each Control Section.
Total Sheet Size, Fig. 4a plus 4b, is 22¼ in. by 15⅞ in.

**STATE HIGHWAY COMMISSION OF KANSAS
HIGHWAY DEPRECIATION LEDGER**

County.....

Route.....

[illegible]

Fig. 4b.—Right Half of Annual Depreciation Sheet for Determining Annual Depreciation and Valuation of Each Control Section.
Total Sheet Size, Fig. 4a plus 4b, is 22½ in. by 15⅞ in.

STATE HIGHWAY COMMISSION OF KANSAS
HIGHWAY PLANNING DEPARTMENT
DEPRECIATION LEDGER DATA SHEET

Division _____
County _____
Route _____
Sheet No. _____ of _____

[illegible]

Fig. 5.—Depreciation Ledger Data Sheet for Consolidating Factors and Recording Adjustment Computations. Size of sheet is 17 in. by 11 in.

Did Rhythmic Gusts of Wind Destroy

TACOMA NARROWS SUSPENSION BRIDGE?

By HALBERT P. GILLETTE
Editor, ROADS AND STREETS



Floor System Inverted About to Plunge Into the Narrows

Credit to Pictures, Inc.

TACOMA Narrows suspension bridge was swung back and forth by rhythmic gusts of wind harmonic with the bridge's pendulistic period, till it was wrecked. This is the theory that is here presented for the consideration of bridge designers.

The failure of a great suspension bridge in a gale is unprecedented. This bridge, whose central span was 2,800 ft., differed from other long spans in having plate-girders instead of trusses. Since plate-girders offer a larger area for wind to push, it has been argued that we

need look no farther for the cause of its failure. Yet even in a gale far greater than the 35-mile an hour gale that existed there on November 7 when the collapse occurred, the area exposed to the wind could not have caused failure had the bridge not swung back and forth with increasing amplitude. And this progressive swinging could not have occurred unless the natural pendulistic period of the suspension span had been harmonic with some cycle of atmospheric pressure. Like a child's swing that goes higher and higher if the pushes upon it are synchronized with its pendulistic period, so a suspension bridge can attain a progressively higher swing if gusts of wind occur in harmony with its pendulistic period—and not otherwise. Let all the gusts come at intervals not harmonic with the period of the bridge, and the bridge will merely vibrate irregularly under their impact. Such vibration could not have wrecked this great structure.

That its pendulistic period was harmonic with a certain cycle of gusts of wind is made evident by the fact that ever since its completion last July it has been given to swinging in strong winds; so much so that people crossing it often became seasick. It was nicknamed "Galloping Gertie," in consequence of such swinging.

A few minutes prior to its collapse a newspaper reporter drove under one end, and then drove nearly to the middle of the bridge, where its swaying was so violent that his car skidded even after applying the brakes. He fled for his life, on his hands and knees most of the way, for the swaying was so violent and so rapid that he could not stand up. The wind was apparently not excessively violent, for it directly affected neither his car nor him. In the Puget Sound region hurricanes never occur, and tornadoes are so rare that only one has been reported in a century. Incidentally that one passed within a quarter of a mile of a highway bridge that I was building across the Nooksack River, without damaging the bridge although it mowed down trees 6 ft. in diameter.

The question arises whether there is any known cycle of barometric pressure that is harmonic with the pendulistic period of this bridge, which was less than 8 seconds. Barometric cycles of this order of length have been recorded. Such short cycles are called microbaroms. See an article by Benioff and Gutenberg in the Bulletin of the American Meteorological Society, December, 1939.

Two years ago I found and published a law relating to weather cycles that I called the triple-progression law. It states that cycles occur in series whose lengths form

a geometrical progression series whose ratio is three. For example there is a cycle exactly 0.2 year or 2.4 months long, and it belongs to a series whose lengths are 0.2, 0.6, 1.8, 5.4, 16.2, etc. years long. It has subcycles of $1/3$, $1/9$ and $1/27$ its length. The shortest of these that is fully established is 2.71 days long, but there is evidence of much shorter cycles in this series, namely one of about 16 minutes in changes of pressure as recorded by the barometer. And if this triple-progression series is carried on to still shorter cycle lengths, there would be cycles of 3.96 seconds. It is noteworthy that there is a cycle of 12 seconds in pulsations of the magnetic needle.

The $1/15$ -year or 24.35-day cycle of this series has a wind maximum November 6 every year, often accompanied by rainfall. The bridge fell the day after that maximum! It is significant that at Seattle the mean daily rainfall curve for 50 years has a minor peak November 7.

In rebuilding this bridge it will of course be wise to substitute trusses for plate-girders. It will be wise also to change the height of the towers, so as to change the pendulistic period of the central span whose progressively higher swinging caused its failure.

Seiches in lakes are pendulistic vibrations of the entire mass of water between opposite shores. These have been studied for 180 years, but not as often as the problem of their causation merits. In Lake Geneva one seich cycle is between 35 and 36 minutes long and is apparently due to an atmospheric pressure cycle whose length is harmonic therewith. In an article on cycles in the October issue of "Water Works and Sewerage," I gave a triple-progression series having cycles of 3.04, 9.11, 27.33 days, etc. If this series extends to shorter cycles, as is probable, there is one of about 17.8 minutes, or half the length of the seich cycle just mentioned. A wind-velocity cycle of about that length is to be seen in data given by Haurwitz in the Bulletin of the American Meteorological Society, June, 1935.

Pulsations of delicate compass needles often show cycles a few second long. The lengths of some of these micromagnetics is the same as that of certain microbaroms. There is a microbarom of about 22 minutes and a microseism (earth tremor) of about the same length. Since correlations between long cycles of weather, magnetism and earthquakes exist, it is probable that similar correlations exist between even the shortest cycles, or microcycles, of all kinds. I infer that the basic cause is cyclic influx of solar electrons.

OHIO IMPROVING U. S. 40

In conformity with the state's general plan of rebuilding U. S. Route 40 across the state, Ohio is finishing grading work on a piece between Hopewell and Edendale. In the accompanying picture Contractor R. Myers of Salem, Indiana, is moving 3,000 to 3,200 cu. yds. of excavation, about half rock, in a 7 hour day. The haul varies from 800 to 1,200 ft. Six Caterpillar D8 tractors towing Athey crawler wheel wagons are kept busy by a Bucyrus-Erie power shovel. Satisfactory fill compaction is accomplished through the inherent characteristics of the hauling equipment—load plus low frequency vibration throughout the mass of the embankment.

In the project there are over 1,000,000 cu. yds. of excavation.



Contractor Myers Outfit at Work Widening for a Line Change

REDWOOD FORMS, CRUSHED ROCK BASE, WIRE BROOMED SURFACE

Features of Concrete Pavement Job at Cottage Grove, Oregon

CONCRETE pavement construction in which the pavement design and the construction equipment are just a little different than ordinarily encountered has just been completed on U. S. 99 in Oregon at Cottage Grove. It completes a portion of another link in the modernization of the Pacific Highway through the state. The Southern Pacific railroad runs through the easterly edge of town and the highway on both sides is adjacent to the railroad, but the old route through town followed the time-honored formula prescribed at the time it was established—of using the main street through the business district. This was accomplished by inserting five curves into an alignment which otherwise would have been tangent, to form a "W" with a total central angle of 288 degs. 54 min., including two right-angle turns.

The obvious location for reconstruction would have been adjacent to the railroad, but this area had been built up with warehouses and other industrial facilities so that the right of way expense would have been prohibitive. Such a location furthermore, would have been detrimental to the future growth of the town. After careful consideration to various routes, the highway commission decided to parallel the railroad, as shown by figure 1, but to leave a 90-foot strip between the highway and railroad for industrial development. While this was not desirable because of cross traffic, and the necessity of four 0 degs. 30 min. reversing curves, two each side of town, with a total central angle of 16 degs. 21 mins., it was felt that the hazard could be partially overcome by building a four-lane divided highway with a 6-foot parting strip and only intermittent cross-street openings.

On May 2, 1940, the grading and paving of the south unit was awarded to Berke Brothers, contractors of Portland, Oregon, at a bid price of \$66,681.00 for the 0.85 mile section. Work was started on May 17, and was completed about October 26, 1940.

The finished roadbed section within the city shown in figure 2, will consist of four 11-foot traffic lanes, divided by a 6-foot parting island, two 8-foot parking lanes, curbs, and two 6-foot pedestrian walks. The section outside the city will comprise two 11-foot lanes with 9-foot rock-surfaced shoulders, and a 4-foot asphaltic concrete footpath on the easterly side near the property line. The pavement is to be Portland cement concrete.



Fig. 1.—Relocation of U. S. 99 Through Cottage Grove Eliminates Right Angle Turns and Speeds Up Traffic

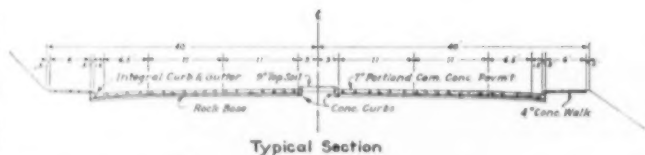


Fig. 2.—Typical Cross Section of Cottage Grove Project. Note Crushed Rock Base Course Six-Foot Parting Strip. Room for Longitudinal Parking Has Been Allowed and Yet Leaves Two Eleven-Foot Lanes

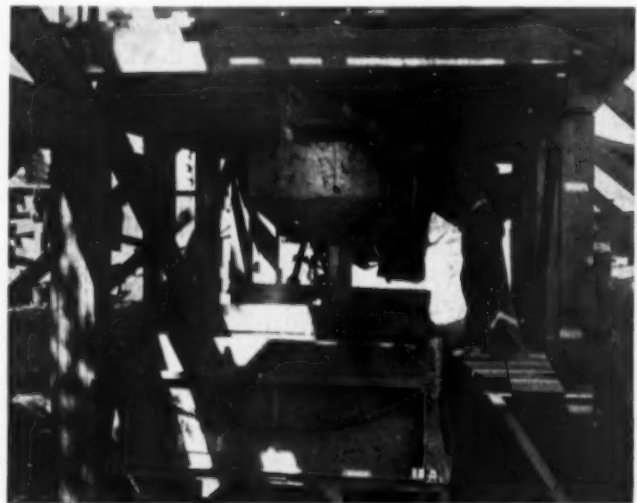


Fig. 3.—Batching Plant Loaded Aggregates Into Two-Batch Trucks



Fig. 4.—Concrete Was Placed on Crushed Rock Base Between Redwood Forms

The grading work was very light and was done with a D8 Caterpillar tractor and a 12 yd. LeTourneau scraper. Compaction was obtained with a sheepsfoot roller pulled by a T-35 tractor, and the finishing was done with an Austin-Western motor grader.

Gravel subbase and crushed gravel materials for the Portland cement concrete, the asphaltic concrete, the surfacing, and the shoulders, were obtained from a gravel bar 2.2 miles from the job. A Koehring $\frac{1}{2}$ yd. shovel loaded the gravel for crushing into two light trucks. This was hauled to a portable Austin-Western crushing plant and then stockpiled on the job near the batching plant.

Some 21,300 square yards of Portland cement concrete pavement were produced by a Rex 7-sack mixer.



Fig. 5.—Ord Strikeoff and Vibrator Prepares the Concrete for the Finishers. Note the Coarse Mix



Fig. 6.—Following the Hand Template a Johnson Bull Float Finishes the Surface on Which Cotton Mats are Placed

operating on a one-minute mixing cycle. Forms were made of Redwood held in place by Redwood stakes. An Ord strike-off machine with an independently operated tubular vibrator in front and a Johnson mechanical finisher were used in finishing. RPM lubricants found favor with the contractor. The finishing bull-float usually made two round trips, after which the surface was given a wire broom finish. Cotton mats were used in

curing. City water for sprinkling and mixing was piped along the easterly edge of the roadway.

Portland cement concrete for sidewalks, curbs, driveway entrances, and small structures was mixed in a 2-sack mixer. Approximately 420 tons of asphaltic concrete were used in paving islands, street intersections, and footpaths.

The work was done under the supervision of R. H. Baldock, State Highway Engineer, H. G. Smith, Construction Engineer, K. D. Lytle, Division Engineer, with E. E. Umphlette, Resident Construction Engineer, in direct charge of the project.

Annual Meeting of National Paving Brick Association

The thirty-fifth annual meeting of the National Paving Brick Association will be held in Toledo, Ohio, January 15, 16, and 17, 1941, at the Commodore Perry Hotel. In addition to the business meetings many of the sessions will be open to the general public. Those interested in modern brick pavements and street and highway development are cordially invited to attend.

The program, now in preparation, will include papers and discussions by prominent engineers, contractors and research men experienced in the use of brick for paving purposes. Important recent developments in manufacturing, experience in research and testing, and in construction methods will be discussed. Among the subjects to be included are the vibrated monolithic pavement, the modern two course pavement, the additional experience with reinforced slabs, and other brick pavement projects which are attracting widespread attention in the highway technical field. The Research Bureau of the National Paving Brick Association, located at the Ohio State University Experiment Station, will make its annual report containing a summary of the principal research projects. These include several cooperative studies with the U. S. Public Roads Administration and state highway departments.

The relationship of the modern brick pavement to the highway problem of the present and future will be an important theme of the convention. This will emphasize the contribution that brick makes to highway safety and its adaptability for heavy duty pavements in metropolitan areas.

C. C. Blair, head of the Metropolitan Paving Brick Company of Canton, Ohio, is President and William H. Cullimore is Chief Engineer and Secretary of the National Paving Brick Association.

CIVIL AIRPORT WORK TO BE DONE BY CONTRACT

The Civil Aeronautics Authority has announced that the airport construction will be handled through the offices of the District Engineers of the War Department.

The Civil Aeronautics Authority also advises that approximately \$35,000,000 of the forty million appropriated for airport construction will be done by *contract*.

Plans and specifications will be on file in the office of the District Engineer for work to be done in his respective area. Bids on the first group of airports will be asked for in about sixty days.

For specific information on fields to be constructed contact the District Engineer in the area in which you are interested.

PONTOON HIGHWAY BRIDGE HAS NOVEL MOVABLE SPAN

Draw Pontoon Design Described

By R. M. MURRAY

Bridge Engineer,
Lake Washington Bridge Project
Washington Toll Bridge Authority.

ON July 2, 1940, there was placed in regular operation a bridge project of decidedly unique characteristics. Within that project was included the construction of a floating cellular reinforced concrete causeway carrying four vehicular travel lanes and two sidewalks. It is the Lake Washington pontoon bridge.

This floating structure is 6620 feet in length, end to end. It is made up of 25 sections fabricated in graving docks, towed to position, connected by means of heavy bolts—one joint articulative about a horizontal axis—structural steel tie-trusses between flanking sections at the draw pontoon opening and held in position by 64 concrete and steel anchors in the lake bottom.

The floating bridge together with steel and concrete spans on concrete piers forming the approaches total a length of 8727 feet. The combined structure effects a crossing of the main body of Lake Washington between the City of Seattle and Mercer Island on a direct route, the re-location of Washington State Road No. 2, between Seattle and North Bend, Washington.

Figure 1 shows the relocation of the state highway, the position of Lake Washington with its influence upon routes eastward from Seattle, and the directness of the new location embodying the floating crossing of the main lake channel.

The lake surface on line with the bridge location is about 8000 feet in width. Water depths range to 202 feet below normal lake surface which is 8.00 on the City of Seattle datum. Deepest water, at anchor locations, is 219 feet.

Over a large part of the width of the channel the bottom is mud, which, for a considerable distance on center-line, is in excess of 112 feet in depth. The length of the crossing and the character of the lake bottom precluded the economic design and use of the conventional type of bridge structure.

Following a period of location investigations, and the decision to start preliminary work looking toward the building of a floating bridge across the lake, activities were begun in the early fall of 1937 to determine experimentally the effects of wind and wave forces to be expected on a floating structure in this location. These experiments were concluded in the spring of 1938.



Fig. 1.—Showing Location of Bridge on Proposed Relocation of State Route 2

Contract plans and specifications were prepared in the State Department of Highways offices in Olympia. Proposals were advertised for and construction contracts awarded in eleven units on December 30, 1938.

The floating structure was built by the Pontoon Bridge Builders and was designated as Unit No. 4. Contract was approximately \$3,350,000.00. An accompanying picture, figure 2, shows cross-sections of the structure and the method of anchor attachment.



Fig. 2.—Cutaway Section Showing Cellular Construction. Method of Anchoring Also Shown

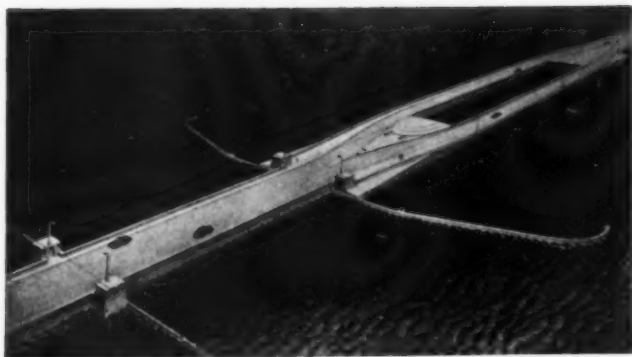


Fig. 3—Artists' Perspective of Draw Pontoon Section. With Pontoon in Closed Position. Lagoon Between Roadways Is Area Into Which Draw Pontoon Is Pulled When Open

Draw Pontoon

Notable feature of this project is the floating draw pontoon. Figure 3 shows a plan of arrangement. This draw opening is placed nearer the Mercer Island end of floating structure approximately on the "lane" followed by large water craft transversing the length of the lake. Here, too, the depth of water—about 75 feet—and firmer lake bottom were such that the timber piles for fenders flanking the ship opening could be placed securely. Figure 4 shows the draw pontoon pulled into the lagoon provided to receive it.

As a part of each approach structure to the floating bridge a tied-arch span 215 ft. c. to c. of end pins has

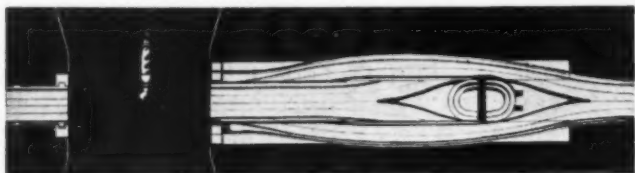


Fig. 4.—Draw Pontoon Pulled Into Lagoon Providing Channel for Boats.

been provided for passage of water craft requiring not more than 30 feet of headroom above water surface. A similar tied-arch span has been built into the fixed structure across the east channel of the lake but with 39 feet of headroom above normal lake level.

The pontoon structure generally is 59 feet in width. The standard units are 350 feet long. Where the draw is placed special pontoon units have been assembled to divide the roadway leaving a lagoon between east-bound lanes and west-bound lanes, as shown by figure 5, into which the draw section may be retracted to provide a 200 foot clear ship opening of unlimited height and ample draft.

Generally the pontoon units are 14 ft. 6 in. in depth. Draft is slightly greater than half of this dimension.



Fig. 5.—Construction View of Lagoon and Divided Roadway Section

The draw pontoon is 59 feet in width but its length is 378 feet. Its weight is a little in excess of 5000 tons. In its travel the draw is guided both horizontally and vertically by heavy cast steel rollers carried by adjustable cast steel arms within the pontoon. These rollers travel on heavy guide bars of mild steel accurately and securely anchored to and within the side pontoons to fulfill complete direction of the draw when moved.

Figure 4, in shaded plan, shows draw in open position providing the 200 foot clear opening for boats. There are four reinforced concrete, steel-and-glass-windowed enclosures at the draw gap—one at each corner. Operating facilities are in the left-hand lower house in plan. Opposite this enclosure, on the other side of the roadway is housed a recording anemometer and rest room. The remaining two buildings are used for tools and miscellaneous equipment.

Sketch plan shows draw pontoon in closed position. Its length has been foreshortened in sketch. When near closed position the draw pontoon is directed to exact line and grade by one retractable, roller-equipped, centering beam and two similar retractable "leveling" beams, working in tapered steel-lined recesses in the end of draw pontoon. Two hydraulic buffers of 6 ft. 8 in. travel assist in gradual closing movement. The centering beam is equipped with a hydraulically actuated wedge device to lock the draw in closed position. These alignment beams are hydraulically controlled that they may be retracted into the fixed pontoon when draw is open and that the ship channel may be free of projecting obstructions.

At the draw opening there is a 202 foot gross length between fixed lengths of floating structure. The east (or Island) section is 948 feet long. West (or City) section is 5470 feet in length. The east section is held against displacement endwise by four longitudinal anchors. West section is held against endwise movement by eight longitudinal anchors attached to pontoons flanking the draw recess. Thus, in spite of temperature effects on length, the draw opening is maintained at a sensibly constant value.

The distance between fixed sections is held practically at 202 feet. The greater part of length change due



Fig. 6.—Draw Pontoon Basin or Lagoon Showing Guide Rails Along Sides.

to rise or fall of temperature is realized at the "City" end of structure. Owing to the design of the draw pontoon the "channel" gap might vary as much as 6 inches without affecting the operation or security of the draw arrangement.

To carry the deflected traffic lanes and sidewalks, and, to provide the lagoon (or recess) into which the movable pontoon may be withdrawn, four special "half-width" pontoon units were fabricated. There are two of these special units, connected end-to-end, on each side. These pontoons lap the end pontoon of standard width about 120 feet and are securely attached thereto. From the back end of the recess to the end of the side

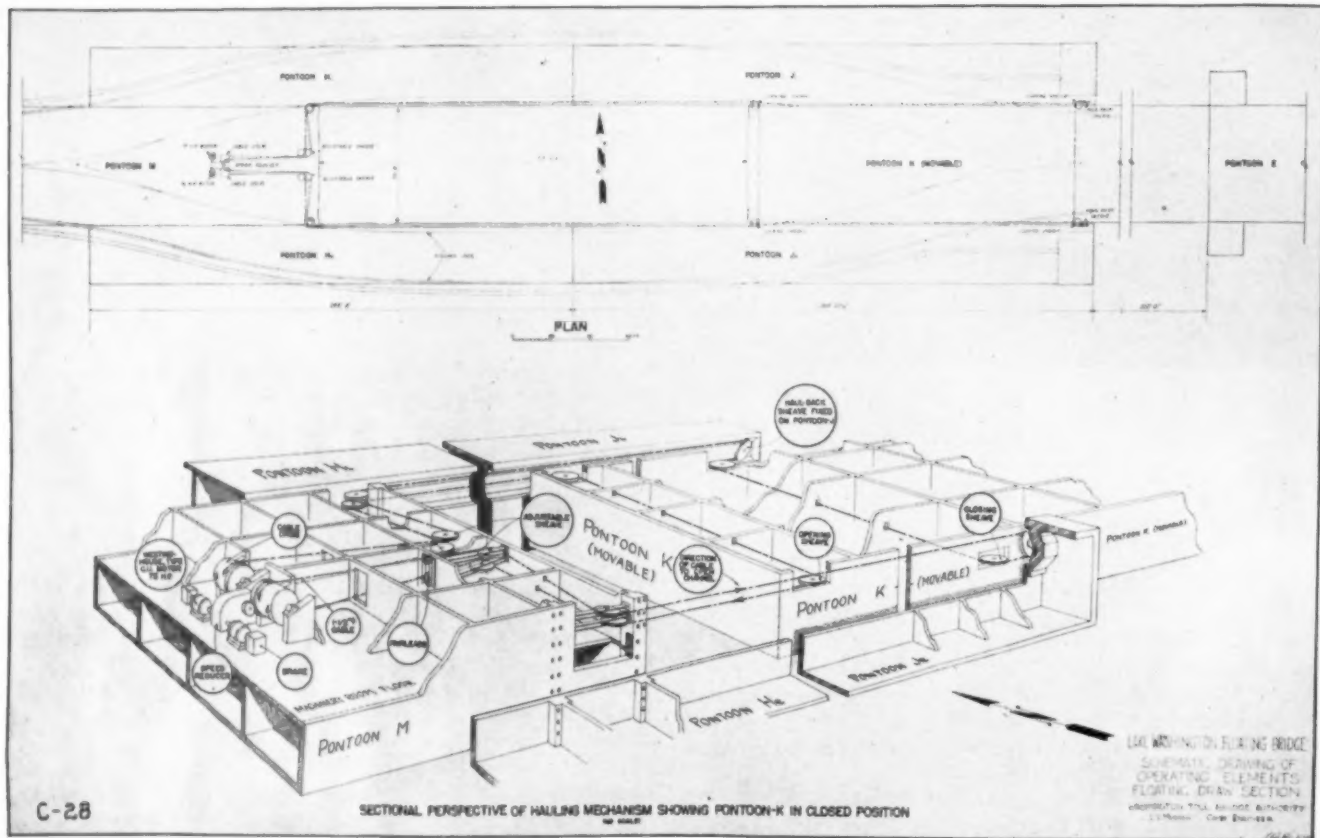


Fig. 6.—Section Schematic Perspective of Operating Mechanism Showing Movable Pontoon in Closed Position

pontoons there is, then, a slot or space between side pontoons, 395 feet in length.

These side pontoons carry the grooves and tracks, figure 6, for the mobile rollers of the movable pontoon. At about half-length of this slot, and, at a line near the outer end of it a welded steel truss assembly, under water, and clear of the movable pontoon, is rigidly attached to the side pontoons.

These ties maintain the side pontoons at exact spacing, keep them from spreading at the outer end under the prying action of the draw pontoon when unlocked and subject to lateral thrust, and, form a link between opposing pulls of the transverse anchors attached in the vicinity.

Displacement

Owing to concentrations of weight of operating enclosures, operating machinery, heavier structural features, steel guide rollers and tracks, etc., greater buoyancy per horizontal square foot was required in the vicinity of the draw assembly than was required of the standard pontoons.

The side pontoons were made somewhat deeper than the regular ones. To further increased buoyancy and to compensate for unsymmetrical loading, steel tank buoyancy units are placed at proper locations under the pontoons and bolted thereto, to maintain the pontoons at regular trim and draft. These tanks are provided with inlet and discharge piping, air lines and valves, and water depth indicators to control their buoyancy effect.

A sectional perspective sketch, figure 7, shows operating machinery, haul cables and sheaves. Propulsion is by two 75 H.P. electric motors connected, through flexible couplings, to a speed reducer. The latter is geared to the operating cable drums. Operating cables are 1½ in. in diameter. Reverse movement of the draw is accomplished by reversing the motors.

Project Personnel

The Lake Washington Bridge Project was planned and built by the Washington Toll Bridge Authority.

Washington Toll Bridge Authority—Gov. Clarence D. Martin, Chairman; Cliff Yelle, State Auditor; Lacey V. Murrow, Director of Highways; Olaf L. Olsen, Director of Finance, Budget and Business; Don G. Abel, Director of Public Service; P. H. Winston, Secretary of Authority.

Construction Engineering Personnel—Lacey V. Murrow, Chief Engineer of Authority; C. E. Andrew, Principal Construction Engineer; R. M. Murray, Lake Washington Bridge Engineer.

Consulting Engineering Board—C. E. Andrew, Principal Engineer, Chairman; Luther E. Gregory, Rear Admiral, United States Navy, Retired; R. H. Thomson, Consulting Engineer; R. B. McMinn, Bridge Engineer, Bureau of Public Roads.

United States Federal Works Agency—John M. Carmody, Administrator, Public Works Administration, Col. E. W. Clark, Acting Commissioner; Regional Director; L. R. Durkee, Acting Project Engineer.

The cost of project was met by a 45 per cent grant by the United States Public Works Administration together with the remaining 55 per cent as realized from the sale of utility bonds. Basic toll rate, for car and driver, is 25 cents.

FEATURE FACTS

- (1) Largest Floating Structure ever built by man. Weight—approximately 100,000 tons.
- (2) First reinforced concrete floating roadway bridge ever built.
- (3) Actually a steel bridge encased in concrete. For every \$1.00 worth of cement, \$3.00 worth of steel was used in building pontoons.
- (4) Reinforcing steel equal to 700 miles of 1½-inch square bars used in pontoon construction.

(5) Cost of floating structure and bridge approaches approximately \$500.00 per lineal foot.

(6) Weight of Floating Structure 13 tons per lineal foot.

(7) Total number of cells in floating structure—1900.

(8) In building the Lake Washington Floating Bridge project 90% of the total expenditure of approximately \$9,000,000.00 was for local materials, supplies, labor and supervision.

(9) An average expenditure of \$16,000.00 was made every day over the 18-month construction period, Jan. 1, 1939, to June 30, 1940.

(10) During the entire construction not a single fatality to workmen. The usual average is one fatality to every \$1,000,000.00 expenditure on heavy construction.

(11) Anchors and floating sections were located by means of short wave radio.

(12) The location of all anchors and the inspection of all underwater work was performed by an experienced diver.

(13) More than 3,000 men were employed for 18 months at going wages, hours and working conditions—1,200 on the job and the remainder behind the lines getting out materials and supplies.

Information in Brief

PROJECT LENGTHS

Seattle Approach Highway.....	2,360 feet
Tunnel and Observation Plaza.....	2,543 feet
West Incline Approach Structure.....	1,062 feet
Floating Bridge Structure.....	6,561 feet
East Incline Approach Structure.....	960 feet
West Mercer Island Roadway.....	6,773 feet
East Mercer Island Roadway.....	7,741 feet
East Channel Bridge.....	1,357 feet
East Mainland Roadway.....	2,086 feet
Mercer Slough Viaduct.....	2,578 feet
Total Project Length.....	34,021 feet

BASIC FINANCING

United States PWA Grant.....	\$3,794,400
Toll Bridge Revenue Bonds.....	5,060,000

WORK PROGRAM

Construction Work Commenced.....	Dec. 29, 1938
Date for Project Completion.....	June 30, 1940

FLOATING STRUCTURE

Number of Standard Floating Sections.....	10
Number of Special Floating Sections.....	15
Length of Standard Floating Section.....	350 feet
Width of Standard Floating Section.....	60 feet
Depth of Standard Floating Section.....	14½ feet
Weight of Standard Floating Section.....	4,558 tons
Height of Roadway Above Water.....	7½ feet
Height of Rail Above Water.....	10½ feet
Width of Roadway—4 Traffic Lanes.....	45 feet
Thickness, Bottom and Outside Walls.....	8 inches
Sidewalks (2).....	4 feet
Thickness, Cell Walls.....	6 inches
Size of Cell.....	14x14x14 feet
Number of Cells, Standard Section.....	96
Length of Floating Draw Span.....	378 feet
Channel Opening.....	202 feet
Diameter Anchor Cables.....	2¾ inches
Weight—Type "A" Standard Anchor.....	65 tons
Total Number of Anchors.....	64

COSTS AND CONTRACTS

Unit No. 1—Northwest Construction Co., Inc.....	\$ 176,129.40
Unit No. 2—Bates & Rogers Construction Corp.....	1,372,320.11
Unit No. 3—General Construction Co.—Columbia Const. Co.....	460,470.00
Unit No. 4—Pontoon Bridge Builders.....	3,253,597.00
Unit No. 5—Puget Construction Co.....	465,147.00
Unit No. 6—Fiorito Bros., Inc.....	257,332.50
Unit No. 7—Dally Construction & Engineering Co.....	169,392.50
Unit No. 8—N. Fiorito, Inc.....	240,393.70
Unit No. 9—Puget Construction Co.....	527,010.00
Unit No. 10—N. Fiorito, Inc.....	60,934.30
Unit No. 11—Rumsey & Co.....	329,332.50

*\$7,312,059.01

* This total does not include costs of right-of-way, engineering and supervision.

Motorists Have a Responsibility in Safe Winter Driving

Motorists using the highways in winter have their share of responsibility for safety and the prevention of accidents is the opinion of T. A. Dicus, chairman of the Indiana State Highway Commission. While the highway workers can remove many of the hazards of winter driving by cleaning snow and ice from the pavement and by spreading abrasives on slippery surfaces on curves and grades, the motorist also has certain obligations to safety by preparing for winter driving conditions.

With "Old Man Winter" sitting on our doorsteps, a new set of safe winter driving rules has been announced by the National Safety Council's Committee on Winter Driving.

From winter driving tests the committee developed the following seven recommendations for motorists.

1. Check brake linings for simultaneous gripping.
2. Good tire treads are helpful but do not provide adequate traction on packed snow or ice. Chains should be put on when needed.
3. Make sure that windshield wipers and defrosters are working and that lighting equipment is in good condition.
4. Travel at reduced speeds on snow and ice, even when protected by chains and watch for children playing with sleds.
5. Keep plenty of room between you and the car ahead in case of need for sudden stops and approach ice or snow-covered curves slowly.
6. Slow down in gear and pump brakes on-off-and-on to keep wheels from locking completely, especially when chains are not being used. Chains do not duplicate dry pavement stopping ability but do cut stopping distance on snow or ice and add to control of car.
7. Exercise more caution generally and open cowl ventilator to force out any gas or fumes that may collect in the car.

To these, A. Puddle Jumper adds the following:

8. On ice or snow, start with a low motor speed and engage the clutch gently. This will avoid skidding the rear end when starting.
9. Do not attempt to drive over 40mph through deep slush. Even chains will be of little help at this speed.
10. On hard packed snow or ice on grades, keep moving in high. If lower gear is absolutely necessary, reduce motor speed slightly so as to keep moving without skidding.

TO INVESTIGATE TACOMA NARROWS COLLAPSE

THE Public Works Administration had a sizeable stake in the Tacoma Narrows Bridge. This administration is part of the Federal Works Agency. Late in November Federal Works Administrator John M. Carmody appointed a board of three men to study and report on the causes of the collapse of the \$6,400,000 structure.

Those named to the board were:

Glenn B. Woodruff, design engineer on the San Francisco-Oakland bay Bridge; Theodore Von Karman, Pasadena, Calif., scientist and authority on aerodynamics; and Othmar H. Ammann, director of engineering, Port of New York Authority.

The results of this inquiry will be anxiously awaited. Of that we may be certain.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER



¶ Pat and Mike were working on a bridge cofferdam near a grove of trees. Pat looked up and saw a skunk sitting on a stump. He looked down and called Mike. Mike looked but the skunk was gone. So Pat wondered why. Mike said the reason was:

The skunk thunk the stump
stunk or the stump thunk the
skunk stunk.
Try saying it fast.

¶ Here another:

Washington's wash woman
washed Washington's wash
while Washington's wife went
west wishing Washington's wash
was washed.

¶ On a new stretch of U. S. 101 north of Santa Barbara, Calif., I saw a good idea. It was lining of bituminous mixture on a side ditch of the road. The road flanked the coast line and the ditch on the outside edge of the road was about 10 ft. wide and 3 ft. deep.

¶ On this farm-to-market road, a few miles north of Council Bluffs, Iowa, this 60-foot cut is being made in a unique way. Instead of a long,

permits vertical slopes without undue erosion. The deep edges are designed to hold blowing snow, keeping as much of it as possible from drifting down onto the roadway.

¶ Herewith pictures of first concrete highway built in New Jersey. The sign says it was finished in 1912.



It is 8/10 of a mile long and as the pictures show, it has been widened by what appears to be concrete.

¶ To alleviate the squeeze from pressure groups, Montana enacted a state law which required that funds for highway work be apportioned among financial districts into which the state is divided. The law also stipulates what percentage of the funds in each district is to be used for new construction and what percentage for reconstruction. The funds are apportioned to the districts by a mileage ratio basis of unimproved roads to total state roads in each district. An article will appear on this later.



¶ L. E. Myers Construction Company at Paris, Ill., was laying gas mains through the city. They were



breaking out the pavement for laying the pipe as shown by the upper picture until they learned about the horizontal hole drilling machine that accurately controlled direction. The lower picture shows how it was possible to lay these pipes without breaking up the pavement. Engineers will welcome this.



continuous slope, as is usual, the contractor has utilized huge steps, which are graded with a 90 deg. set on a Caterpillar motor grader blade.

The soil in these bluffs along the Missouri River is of a texture that

¶ Johnnie Fenn, bridge department, Montana State Highway Commission, says, "A girl's word of honor is 'No'."

¶ In an editorial entitled "Road Transport for India," pg. 202, Nov. 1940, the British magazine "Road and Road Construction" suggests "development of a road system in India be entrusted to the United States in return for a monopoly of road transport in that country for a limited period of years."

¶ B. C.—Do you know how to make holy water?

A. P. J.—No. How?

B. C.—Just boil the hell out of it.

¶ An editorial in "Road and Road Construction," a British publication suggests that American universities should train Indian engineers for the task of road development in India.



¶ Reflector buttons are installed in marker posts in Nevada. Holes are bored so that buttons fit tightly. They are pounded in with a soft mallet.

BRIDGE BUILDERS' SUPERSTITIONS*

By R. A. STEPHENSON

*Bridge Construction Engineer,
Montana State Highway Department*

Superstitions relating to bridge building date back to the ancients. The earliest evidence of superstition, that of human sacrifice, can be traced to the early peoples, who knowing that water formed a natural barrier to human enemies, assumed that great rivers also afforded protection from evil spirits. To appease the anger of the gods for bridging such a barrier, it was only natural that human sacri-

fice should be offered by the Romans and others of that age.

Although the practice of human sacrifice now belongs to the past, it has been stated on reliable authority that a bridge built in India about 1900, is supported by piers under which lie the skulls of infants placed there by superstitious natives. (It seems that a leaning towards the practice of using young children for such purposes originated on account of the inability of the victims to offer serious resistance.)

It is generally accepted that people whose work involves unusual hazards are notably superstitious. It takes a cool, sure-footed, (and to the casual observer, reckless and almost foolhardy) man to walk along the narrow flange of a beam high in the air, hook his legs around the steel, and lean out to drive home a driftpin. But behind this "front", there are certain customs and superstitions which are firmly implanted. For example, many steel workers will not stay on a job during the remainder of a day on which some unfortunate fellow slips to his sad demise. Perhaps this is out of respect for the lost comrade, but it may also be in recognition of the nervous condition of the remaining workers.

During the recent erection of a tower for a suspension span, a white pigeon circled around and then alighted near the top of the structure. A few of the steel workers considered this a very bad omen and wanted to quit; others scoffed; but whether a coincidence or the result of nervousness, a few minutes later a man fell to his death. Needless to say, all work stopped immediately for the day regardless of the fact that the contractor was working against a penalty for overrunning his contract time.

European steel workers have an interesting custom of placing their country's flag above a structure when the last bolt is in place. This is now considered merely as a sign of achievement. However, it is a custom that did not begin in the steel age, but can be traced back so far that no one knows when it began or what it meant.

A common belief in some South American countries is that some terrible disaster will follow the use of a bridge constructed without any loss of life. Apparently, this is a relic of the days of human sacrifice. In any event, it is probable that the insurance underwriters would hold an opposite view. As a point of interest, the Lake Washington Toll Bridge was constructed without the loss of a single life, a record which has not been equalled on many structures.

It has been said that "Big bridges are built under water". The smallest of bridges require foundations, consequently it can be readily recognized that foundations for large structures often involve serious problems. Sinking of caissons, wherein the water is prevented from rising inside the pier by the introduction of compressed air, is probably the most dangerous to the health of the workers. Caisson workers often develop "The Bends", or caisson disease, from a too rapid change in atmospheric pressure.

Before scientific research established the exact cause of the "bends", many superstitions developed. About this time, the "mystic force" of electricity was undergoing wide experiments and was given considerable publicity. Caisson workers associated the "bends" with electricity, with the result that they wore bands composed of zinc and silver on their wrists, ankles, and around their waists. These metals, when in contact with each other and with moisture, generate a mild electric current which was believed to protect against caisson disease.

Another superstition among caisson workers is the belief that a death will follow the entrance of a woman into the air chamber. Whether or not this is a variation of the "woman-hater" theme, is not known.

Due to improved air chambers, caisson disease is quite rare today, however, during the construction of the Eads Bridge over the Mississippi River at St. Louis, fourteen men died from this cause, and many more were permanently disabled. The Eads Bridge was the first caisson job in this country. Deaths and disabilities became so prevalent that finally the Illinois authorities threatened to close down the work if another single casualty occurred. It is said that the contractor then obtained a fast motor boat and any time a worker "passed out" in the caissons, he was rushed to the Missouri shore, where a physician awaited to certify that the death occurred in that State.

Add to these the common superstitions relating to the number thirteen, the beginning of an undertaking on Friday, and similar beliefs, and you will find that bridge erectors' superstitions are in general founded on some primitive custom, where origin and meaning has long been lost. But the custom still exists.

Statistics show that the majority of workers on the Golden Gate Bridge and other high structures built in recent years, were born below the Mason and Dixon Line. The reader is free to figure this out for himself.

*From the Center Line, a publication of the Montana State Highway Department.

Household goods belonging to 1,000 officers and enlisted men were recently hauled by truck from Hamilton Field, San Francisco, to Fort Douglas, Utah.

American Road

WASHINGTON, D. C.

LEADING HIGHWAY-MILITARY EXPERTS

Down the Road

By CHARLES M. UPHAM

*Engineer-Director,
American Road Builders' Association, Washington, D. C.*

GOOD ROADS FOR CHRISTMAS

What do you want for Christmas? This question today takes first place in millions of minds. Yuletide shoppers carefully study advertisements that feature gifts for every taste and purse. They search the stores for exactly the right present for Mother and Father, Brother Bill and Sister Sue, Aunt Mary and Cousin Tom. While it is more blessed to give than to receive, each person undoubtedly also thinks of things he would like to find in his own Christmas stocking. The list of gifts he hopes to receive is second in importance only to the list of presents he plans to bestow. The younger members of his family put their wishes on record in letters that begin "Dear Santa Claus."

It would indeed be satisfying if adults, too, could look to a benevolent saint for gratification of their deepest desires—not just for neckties and slippers and the traditional Christmas presents, but for the big, important wants that can make it a happy New Year from January through December. If every American made a list of such desires, we would probably find that, though the lists would vary in many particulars, they would, in their broader aspects, be very much alike. For each petitioner would ask the things he thought best for himself, his family and his country. I am sure that the word "road" would appear somewhere on every list.

The farmer's list would carry specific requirements for an improved road past his farm—one that would serve in all weather to transport his produce to market, his children to school and his family to town for social and cultural activities. The country doctor wants a county network of good roads to take him to his patient's door with no delay. The city dweller wants broad, smooth highways to carry him to beaches, parks and other far-off places when recreation and vacation call. The wise parent

wants accident-proof thoroughfares over which his children can travel without risk of life or limb. The far-sighted businessman wants his state to have the good roads that attract tourist trade and dollars. Thirty million American motorists want state roads and city streets on which they can safely, swiftly and comfortably drive for business and for pleasure.

Even the man who does not operate a motor vehicle has good reason to place roads high on his Christmas list. His interest in his nation's welfare—which directly affects his own—prompts him to ask for a modern national highway system. Much of this food and other things indispensable to good living are transported over roads by truck. Better roads and growth in traffic will improve business prospects in all industries connected with highway transportation, with consequent increased employment and lowered relief costs that will mean substantial savings for him as a taxpayer.

At the head of the list of every patriotic American must be the continued peace, prosperity and progress of the United States. He knows that better roads are needed for the transportation of raw materials and finished products to facilitate the present preparedness program. He knows that, in the event of an emergency, adequate highways and bridges would be vital to the movement of troops, arms and supplies. Roads would appear on his list next to the army and navy as lifelines of our national defense.

Country man and city man, motorist and pedestrian, militarist and pacifist all have a common desire for better and safer roads. During this season of the year men in all walks of life also share the Christmas spirit, a spirit of giving and of good will. I sincerely trust that for all of you this Christmas will be merry and that the New Year will be the happiest yet. And I hope that you get what you want for Christmas!

PAN-AMERICAN DIVISION PRESIDENT ADDRESSES AAA

Luis Montes de Oca, president of the Mexican Automobile Association and of the ARBA Pan-American Division, addressed the 38th annual convention of the American Automobile Association at Washington, D. C., November 15. He advocated that completion of the Pan-American Highway be made an issue in the American defense program. Jose Rivera, MAA general manager and Pan-American Division secretary, and MAA Vice-President Cayetano Blanco Vigil also attended the convention.

KENNEDY NAMED MICHIGAN HIGHWAY COMMISSIONER

G. Donald Kennedy has been appointed Michigan state highway commissioner. He succeeds ARBA Past President Murray D. Van Wagoner who resigned following his election to the governorship on November 5. Commissioner Kennedy was formerly deputy commissioner in charge of business administration. His connection with the state highway department began in 1933.

IDAHO, NEVADA, SOUTH DAKOTA OUTLAW ROAD- FUND DIVERSION

Idaho, Nevada and South Dakota joined the list of states that bar diversion by constitutional amendments by popular vote at the November 5 elections. Under the terms of these amendments, the state legislatures cannot use motor-vehicle taxes for non-highway purposes. A total of eleven states now have anti-diversion amendments.

HIGHWAY EMPLOYMENT STUDIED BY ARBA ECONOMICS DIVISION

A detailed study of employment is being conducted by the ARBA Highway Economics Division. Purpose is to determine the possibility of materially reducing unemployment through an enlarged highway-improvement program. Significant facts brought to light by this survey will be revealed at the 1941 ARBA Convention in New York City.

Builders' Review

DECEMBER, 1940

WILL ADDRESS ARBA 1941 CONVENTION

Huntsville, Tex., has the shortest state highway in America. Two blocks long, it is designated as State Highway 219 and leads to Sam Houston's grave.

Opening gun in 1941's battle for highway preparedness will be fired at the American Road Builders' Association Convention in New York City, January 27-31. Highway and military experts, federal and local government officials, educators and economists lead the list of Convention speakers. Tentative program for the Contractors' Clinic is typical of the outstanding discussions planned for all Convention sessions. Addresses will include "Stop Thief" by E. E. Duffy, Portland Cement Association Highway and Municipal Bureau, Chicago; "Current Federal Laws and Regulations Affecting the Highway Contractor" by Francis J. Kelly, ARBA general counsel, Washington, D. C.; "How to Reduce Compensation Payments" by W. H. Seymour, vice-president and manager, Liberty Mutual Insurance Co. Loss Prevention Department, Boston; "Operation of the Merit Rating System Under the Social Security Law," "Depreciation and Rental Schedules for Equipment" by Eldon M. Farnum, George F. Smith Co., St. Louis; "City Street Maintenance by Contract" by Captain H. C. Whitehurst, District of Columbia director of highways, Washington; "WPA Management Contracts" by Albert Mahon, Union Paving Co., Philadelphia, and "Pitfalls of Bidding" by Professor Walter G. Sadler, division of civil engineering, University of Michigan, Ann Arbor. Discussion will be led by A. E. O'Brien, secretary, Associated Pennsylvania Constructors, Harrisburg, and ARBA Contractors' Division President Herbert R. Anderson of Chicago will preside.

ARBA President and Ohio Highway Director Hal G. Sours will address the "Roads-for-Defense Forum" on the opening day. Among other notables scheduled to speak at this meeting is R. M. Smith, deputy minister, department of highways, Toronto, Canada, who will discuss the new Queen Elizabeth Highway. Conventionites will also hear E. Donald Sterner, New Jersey state highway commissioner, Trenton, on "East Coast Express Highway"; General Robert Lee Bobbitt, member, Texas State Highway Commission, San Antonio, on "We Learned a Lesson," and George E. Spargo, executive officer, New York City Department of Parks, on "Parkways and the Public."

County officials will discuss the importance of county highways to national defense and hear reports on legislation, finance and administration, organization, technical problems and governmental relations. Allan M. Williams, engineer-manager, Ionia County, Michigan, Road Commission; Paul

1941 CONVENTION TOUR SIGHT



Pictured above is one of many interesting modern highway construction projects that will be inspected by delegates to the ARBA 1941 Convention in New York City. From the Harlem River Speedway, a massive structure of sweeping ramps and multiple levels leads to the new tunnel under Washington Heights and crosses Manhattan Island to connect with George Washington Bridge. Several inspection tours of similar projects are to take place during the course of the "Roads for Defense" Conclave.

B. Rynning, Jackson County, Oregon, engineer; Otto S. Hess, engineer-manager, Kent County, Michigan, Road Commission, and Alan N. Buck, Macon County, Illinois, superintendent of highways, will speak, with L. V. Belknap, County Highway Officials' Division, as presiding officer.

The first meeting of the new ARBA Highway Economics Division will hear Dr. Miller McClintock and Maxwell Halsey, director and associate director, Yale University Bureau for Street Traffic Research, New Haven, Conn. ARBA Planning Division President S. S. Steinberg, dean, college of engineering, University of Maryland, College Park, has planned an outstanding program for the Planning Clinic. Needs in highway education will be stressed at the Educational Clinic, under the chairmanship of ARBA Educational Division President A. Diefendorf, head, department of civil engineering, University of Utah, Salt Lake City. National defense needs

will be featured at the Technical Airport Conference, with Airport Division President Floyd E. Evans presiding.

Entertainment will hit a new high at the 1941 Conclave. The Road Builders' Mardi Gras, annual banquet at the Waldorf-Astoria, will break all records for gayety. The "good neighbor" policy will take a bow at the Pan-American Fiesta and the "good old days" will have hilarious revival at the Old Timers' Reunion.

FLORIDA SECTION MAKES ARBA CONVENTION PLANS

The Florida Section's "On-to-New York" Committee has selected the Hotel Astor as Section Headquarters for the 1941 ARBA Convention. A large delegation will leave Florida by plane on January 25. Committee members are M. M. Frost, chairman; John E. Ballenger, R. L. Banerman, W. A. Shands and D. F. Taylor.

SUB-GRADE TREATMENT BY MUD-JACKING AND FILLING

How Illinois Corrects "Pumping" Joints and Sunken Slabs

PART TWO

The first part of this article was published in the November issue

By PAUL J. KUNZER
Junior Highway Engineer,
Illinois State Highway Department

Mud-Jack and Auxilliary Equipment

Equipment required to operate the mud-jack in our method of subgrade treatment consists of a truck on which a second 105-cu. ft. air compressor is mounted. The truck also pulls the mud-jack and trailer tank. A small utility truck is kept on hand. The personnel is as follows: one foreman; one man operating the compressor and air spade to vent the shoulder at the edge of the pavement at a crack or joint (Fig. 14); four nozzlemen; one man operating the mud-jack and stirring the mixture in the trailer tank to keep it from settling; two men cleaning up the pavement and bringing the plugs forward; one flagman.



Fig. 14.—Venting a Pumping Crack

The batch trucks have been boxed up and a door provided for loading. This was necessary to prevent the splashing out of the mixture. A short 4-in. pipe with a plug was welded on the tail gate for discharging. The trucks back up to the trailer tank, which has an extended chute into which they discharge. Fig. 15 shows a truck discharging. This tank, an open water tank mounted on a trailer, holds 2½ cu. yd.; but since the mud-jack must have a by-pass our loads are limited to 1½ yd. The tank has a 6-in. opening at the bottom near the front, and is connected to the mud-jack with a 6-in. suction hose. Fig. 16 shows this hose (bottom) hooked up to the suction valve of the mud-jack and the by-pass or overflow hose (top) from the mud-jack to the tank.



Fig. 15.—Batch Truck Discharging Into Trailer Tank Parked on Shoulder

The mud-jack has two pistons, and for our purpose one piston has been arranged with a valve to suck the mud from the tank—the other to pump it through the hose and nozzle. Special valves were required and special blades in the mud-jack to carry the mud through to the pumping piston and cylinder. Thus, we get a pulsating flow of mud from the mud-jack which is desirable in that not too much pressure is created under the slab. A constant pressure or flow of mud would be so great in so short a time as to crack or break the slab, if it had not already broken our hose lines. The by-pass, or overflow, is necessary to carry the excess mud back into the tank when all the nozzles are not in use at the same time.

From one to four nozzles may be used for injecting mud. We are now using four, as shown in Fig. 17. Notice how the work of pumping is now consolidated near the machine, since the extreme nozzles have worked themselves inward. The mud hose is 2 in. high pressure type tested to 600 pounds. Our lengths are one 50 ft., two 75



Fig. 16.—Mud Jack and Connections to Tank Containing Sealing Mixture



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ft. and one 150 ft. Air hose used in conjunction with the mud hose is light weight $\frac{1}{2}$ in. diameter. Each nozzle has a mud and air hose attached. The nozzles work independently of the mud-jack, and the entire operation is in the hands of the operator with the exception that due to the pulsating flow delivered by the mud-jack, mud can only be forced through the nozzle on the pumping stroke of the piston. The nozzles have two separate and independent valves for the mud and air lines.

The bottom, or nozzle point, fitting into the holes is of steel tapering from $1\frac{1}{2}$ to $1\frac{1}{4}$ in. and is replaceable. Just above it, a splash plate is provided to protect the operator and hold the nozzle in position. A handle is



Fig. 17.—Crew and Equipment at Work. Nozzle Men Are Working Toward the Center of a 250-ft. Stretch

provided for ease in carrying the nozzle, and a weight is added around the shaft to be used as a hammer to drive the nozzle firmly into the hole.

Details of Lifting and Sealing Operations

The nozzleman has two operations to perform: (1) lifting the slab to take out the movement and settlement; and (2) sealing the voids along the cracks and joints.



Fig. 18.—Close-Up of a Nozzle in Service

In lifting, the operator does not use air pressure because the air would immediately create an opening at the edge of the pavement and the mud would be pumped out from under. Depending on the height of the lift and the number of holes required to raise a section of the slab, the operator pumps the holes back and forth usually commencing at the lowest point of settlement. The lifting operation is identical to that of the ordinary mud-jack used for the purpose. If a nozzle does not have sufficient pressure to raise the slab (a rare occurrence), one or more of the other nozzles are shut off as required.

In sealing the voids and cavities air pressure is used, and we believe it to be the essential part of the operation. Keeping our purpose in mind, it is evident that the mud mixture must not be too thick, and without the air the pressure produced under the pavement would cause it to rise long before the voids would be filled. Once the pavement begins to rise at the sealing holes no more mud should be pumped. Thus the air serves to drive the mud mixture into all cavities without lifting the slab.

The operator first gives the hole a shot of air to drive out any water trapped between the slab and sub-grade. The water finds its way out at the joints, cracks and adjacent holes. He then shuts off the air and turns on the

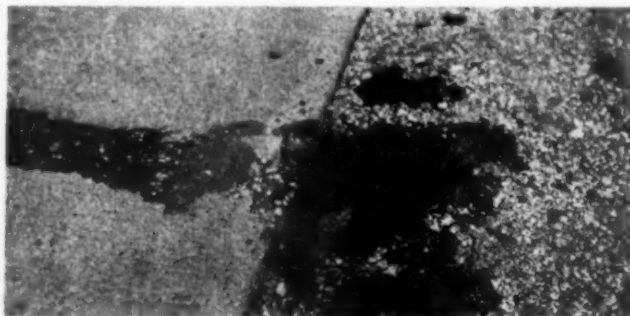


Fig. 19.—Mixture Just Blowing Out at End of a Crack

mud, which usually flows in all four directions from the hole along the joint or crack and the center steel, since that is where the largest cavities exist. This performance of mud on air is alternated until our mixture blows or is pumped out under the edge of the pavement where it has been vented. Fig. 19 shows the mixture just blowing at the edge of a crack. Were the edge of the pavement not vented, we would not know when the mud had filled and sealed all the openings. We assume that such is the



Fig. 20.—Mud Mixture Blowing Up through a Contraction Joint

case when it blows out. Venting also provides an outlet for any free water trapped beneath the slab. Fig. 20 shows our mud-mixture being forced out along a contraction joint. The mud has not yet flowed to the edge. Thus, besides sealing the voids underneath we also are sealing the voids in the joints and cracks, which is another reason for the necessity of a plastic mix.

When the operator removes the nozzle, he quickly inserts a plug to keep the mud under the slab until it has reached a set. Back pressure would allow considerable of the mud to ooze out, especially with traffic constantly passing by. The pulsating flow of mud from the

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mud-jack has proven its desirability inasmuch as we have yet to crack our first slab. About half an hour is required for the mix to set, and it reaches a firmness in about two hours. The drying out stage requires about three days.

The compressor runs two lines of air hose. A 120 foot length for the air spade used in venting (a pick serves the same purpose) and a short line to the mud-jack to which the four air lines for the nozzles are attached. A short section is also hooked up from here to the mud hose attachment to clean and blow out the mud hoses at lunch time and at the end of the day's run. Fig. 21 is a close-up of the mud-jack from the pumping side. It shows the air and mud line attachments with only one of the lines hooked up.

The mud-jack is operated under a pressure of 60 pounds, which we have found to be sufficient for our purpose, although about four times as much pressure can be had if required. The air compressor operates at a 95 pound pressure, also sufficient.

The mud-jack and other wheeled equipment is located



Fig. 21.—Mud Jack from the Pumping Side. The Trailer Tank Is Loaded with Equipment Ready for Moving

on the shoulder during operations. As previously stated, practically all the work is performed on the outside lane. The inside lane has very few settlements that require lifting, and those only at culverts. The inside lane is kept open to traffic, and as pointed out previously the sealing holes are located towards the outside lane from the center steel crack. Thus, traffic does not interrupt our progress.

A stretch of 220 ft. is completed in one set-up before the equipment is moved forward. One set-up usually requires one truck load of the mixture. Work is started with one nozzle at each end of the stretch (the rear nozzle is attached to the 150-ft. length of hose) and two at the center. End and center operators thus work toward each other, and are able to help each other when close together or near the completion of a section. This keeps the work progressing at all times in case one operator runs into difficulties.

A joint is never vented if the slab needs to be raised at that point. In such a case, the mud-mixture again would be pumped out before the slab could be raised. The nozzleman then must be careful in sealing so as not to "tee" up the slab where the sealing hole is located. He must use good judgment as to the amount of mud required to seal the voids in such a case.

At the end of a day's run, the equipment is brought back to the plant. Two men run water through the complete system, thoroughly cleaning the tank, the suction and by-pass hose, the four mud lines, and nozzles. The valves must be disconnected and scraped due to some settlement and separation of cement which has hardened along the various parts of valves and cylinders.

Results and Anticipations

The work is being done with a maintenance crew of the Division of Highways, State of Illinois, District No. 1, and is under the direct supervision of an engineer keeping an accurate record of all work and costs. As previously stated our results have been favorable, and this method appears to be the correct solution to a difficult problem confronting not only this, but all highway departments.

We have had numerous rains on the completed sections. At first, a rather large number of cracks and joints showed "pumping action," but it was not our mixture that was pumped out. It was still the old sub-grade material, indicating high shrinkage in our mixture. An estimate placed the joints again pumping at about 10 per cent of those that showed pumping previously. At that time about 3 miles of pavement had been treated but we were not venting the edge of the pavement. It must be said that those points showing pumping again were formerly pumping excessively and had considerable slab movement. We changed our mix by the addition of the clay to get more weight and body, vented the edge, and since then the results have been almost perfect, the most recent rains having indicated not more than 2 per cent pumping over the entire length we have covered to date. Very little slab movement can be detected, and even where it is, it doesn't seem to cause any harm, for no further settlement has resulted. We don't profess to believe that a permanent cure can be found, but should the present 2 per cent be increased by next year, it will be a simple matter to re-seal at a cost considerably less than this year's. We anticipated a further destructive development along sections with very little pumping action, and these will be sealed by this method to prevent its occurrence.

Another indication of the good results obtained to date is that on the sections completed not one yard of pavement replacement will be required this year; whereas, last year 250 square yards of replacement were required.

The cracks and joints are now being tarred and sealed on the slab, and the holes are being plugged with a mixture of sand and asphalt emulsion. Such a mixture can be readily removed for re-sealing and will not be pulled out by traffic in the meantime.

Progress, Data and Cost

We have been averaging a length of 4,000 ft. of 20-ft. pavement per day, and pumping 23 cu. yd. of the mud-mixture. Our best days cover a little over a mile. The amount and height of lifting, sub-grade condition, and weather affect our day's runs.

To date we have covered a length of 36 miles, and have treated 425,000 sq. yd. of pavement, in which 30,000 sq. yd. were lifted an average of $\frac{3}{8}$ in. In this area, we have pumped 1,300 cu. yd. of the mud-mixture, an average of approximately 6 cu. ft. being required to treat one 30-ft. section of pavement. We have used up 33,000 gal. of oil, 900 barrels of cement, 160 tons of lime dust and 425 cu. yd. of soil.

At the present time our cost is running approximately $3\frac{1}{2}$ cents per square yard treated, or \$12 per cu. yd. of mixture pumped; but the cost for the entire job since we started will be at least double those figures, due to the time lost in the purchasing of new equipment, repairs, organizing and familiarizing the men with their duties, and the continual overhead during the period at which the equipment was being re-built and over-hauled. Even these higher figures can be seen to be extremely reasonable for the work done; and the value of results attained far outweighs all costs.

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WOOD AS A STRUCTURAL MATERIAL

A Review of Certain Qualities and Characteristics Which Contribute to Its Wide Range of Uses

PART TWO

By FRANK J. HANRAHAN

*Structural Engineer
National Lumber Manufacturers Association*

The first part of this article was run in the November issue.

Decay

Wood in order to decay must be used under conditions which are conducive to decay. Decay in wood, frequently called "dry rot" in building and construction work, and characterized by brownish discoloration, a crumbly appearance, and formation of cube-like pieces of rot due to shrinkage when dried, is caused by tiny plants called fungi. Those fungi which cause wood molds and stains do not attack wood substance, and therefore should not be confused with decay organisms. In addition to the presence of the fungi, at least four things are necessary simultaneously for development of decay: (1) an abundant food supply, (2) favorable temperatures, (3) sufficient air, and (4) sufficient moisture.

When it is considered desirable, the food supply can be made toxic to fungi by preservative treatment of the wood.

Optimum temperatures favorable to the growth of a large number of fungi range from 68 to 97 degrees F., but at these temperatures relative humidities in excess of 90 per cent must be maintained in order that there be sufficient moisture in the wood to permit fungi growth. Only one of a great number of fungi will survive a temperature of 115 degrees. Kiln oven temperatures kill all fungi. Although fungi may not be killed by low atmospheric temperatures, they do not grow at low temperatures. This is one of the reasons that in the design of Byrd's wooden shelters for use at the South Pole no consideration was given to fungi growth, even though a large amount of condensation takes place in the buildings.

Since sufficient air is not available, decay will not develop in wood which is completely saturated; for example, when submerged in water. The air supply in the soil becomes deficient a few feet below the surface of the ground and at depths more than 5 or 6 feet the rate is usually very slow, especially in dense compact soils. Recently, there was uncovered in Boston untreated wood pipe which was laid in the ground in 1826 and served as part of the Washington Street sewer in Boston for over 110 years.

Decay does not develop in wood having a moisture content below 20 to 30 per cent of the oven-dry weight of the wood, which is near the fiber saturation point. In this case, sufficient moisture is not present for fungi growth.

Lack of conditions fulfilling any one of the four requirements mentioned above inhibits fungi growth, and therefore, decay. Wood, under most conditions, is a very durable material. There are old wooden buildings and other structures which, although built many cen-

turies ago and untreated, are still in good condition. In the case of a temporary structure, or one of limited service life, conditions favorable to decay may not be of serious consequence due to the relatively slow action of decay. In more permanent structures under conditions where sufficient fungi growth may be expected to warrant attention, increased section may be provided to compensate for this in a manner similar to that for the corrosion of metal. Where conditions are favorable to considerable fungi growth, the use of the heart wood of the more durable species or preservatives should be considered. When preservatives are used, it is sometimes advantageous to prefabricate the members; i.e., trim to size and bore holes and connector grooves, before treatment.

However, when conditions unfavorable to decay can be obtained economically by common sense application of the above scientific facts, it seems the logical thing to do. Factors for greater service life of wood are: separating or protecting the wood from the soil or other sources of moisture, not embedding wood in concrete or masonry without provision for adequate ventilation to carry off moisture or waterproofings of the masonry, adequate flashing, adequate provision for carrying off condensation on metals and leaky pipes or roofs; in other words, provisions for protection from excessive moisture for a considerable length of time, unless sufficient air is excluded.

In any case, since the action and requirements of fungi are adequately known, there is no excuse for appreciable decay in a wood structure. Decay in wood structures is an indication of lack of knowledge by the designer or faulty construction practices by the builder.

Termites

Science has ascertained the life habits and life requirements of termites. It has also devised inexpensive preventative measures for new construction and curative remedies for infested structures. Many people have been misled into believing that termites are a comparatively new scourge, that they are rapidly increasing and spreading and that they cause widespread and enormous damage to wood structures. They do cause considerable damage in certain infested areas when proper precautionary measures are not taken, but here are the facts:

Fossil termites of the same destructive species found in the U. S. today which indicate the existence of their colonies fifty-five million years ago have been found in this country. Therefore, termites antedated the human race on this globe.

Scientific investigations have shown that termites are more numerous in the southern, southwestern and the

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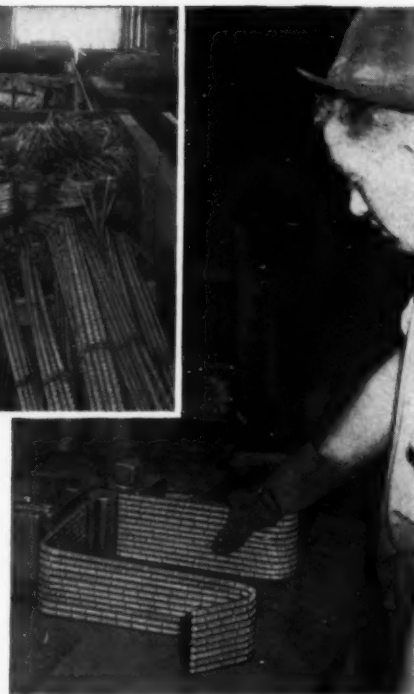


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southern Pacific coast regions than elsewhere in the United States. Also that there have been no introduction or spread of termites from the tropics to the United States nor of the native forms from the southern to the northern states.

The destructive termites in this country; namely, the subterranean type of termites, must maintain contact with the ground in order to obtain the unfailing source of moisture which is necessary for their existence. The workers, who are the only destructive members of the colony, enter the structure from underground communities through foraging tunnels. These passageways may be through cracks in concrete or masonry walls, through wood or through earthlike shelter tubes built over the materials. Wood is but one of the substances which termites attack, and not all termites attack wood. They are blind, shun the light and avoid exposure.

Therefore, in localities where termites are known to exist, the logical precautions are to prevent their entry into the structure, expose them to the air, or cut off their contact with the moisture in the ground. In new construction and where the expense is warranted in old construction, this is accomplished by placing tight non-corroding metal shields between the foundation and the wood superstructure, as well as around pipes, conduits and other possible points of contact. These shields should extend outward and downward for about 2 in. to prevent the building of shelter tubes around the shields. The design and installation of termite shields should conform to definite standards recommended by the United States Bureau of Entomology. The shields should be placed several inches above the ground level, and the weeds and other rubbish surrounding the structure should be kept well below the level of the shields. Where termite shields have been properly installed and maintained there is no known case of damage to the structure.

In old structures containing termites, if it is possible, the contact with the ground should be broken and the wood structure sealed off. If this is not feasible, it may be necessary to attempt to locate the colony and use a soil poison as a more or less temporary measure for preventing termite damage. An economical soil poison is one part creosote oil to 2 or 3 parts kerosene or mineral spirits (dilution depends on density of soil). If the odor of creosote is objectionable, (it will disappear in a short time if there is proper ventilation) orthodichlorobenzene (full strength) or paradichlorobenzene crystals may be used. The treatment should be followed by periodic inspections. Detailed instructions for installing shields or ground treatment may be obtained from the lumber manufacturers associations.

Fire Resistance

Fire resistance and incombustibility are not synonymous. In most cases it is the contents of the structure rather than the structure, itself, which originates and feeds the fire; and substantial timber construction will stand up much longer than unprotected steel. The "fire-proof" building is essentially a myth. This point is emphasized in the following excerpt from the *Washington Post* in which Fire Chief, Charles Edward Schrom, who has been a Washington, D. C., fire-fighter for 46 years, is quoted:

"There's really no such thing as a fireproof building," declared Chief Schrom, who considers the hardest work he ever did the 12 hours he put in two years ago trying to put out a fire on the sixth floor of the 'new fireproof Postoffice Building'."

Some other important factors to be considered are pro-

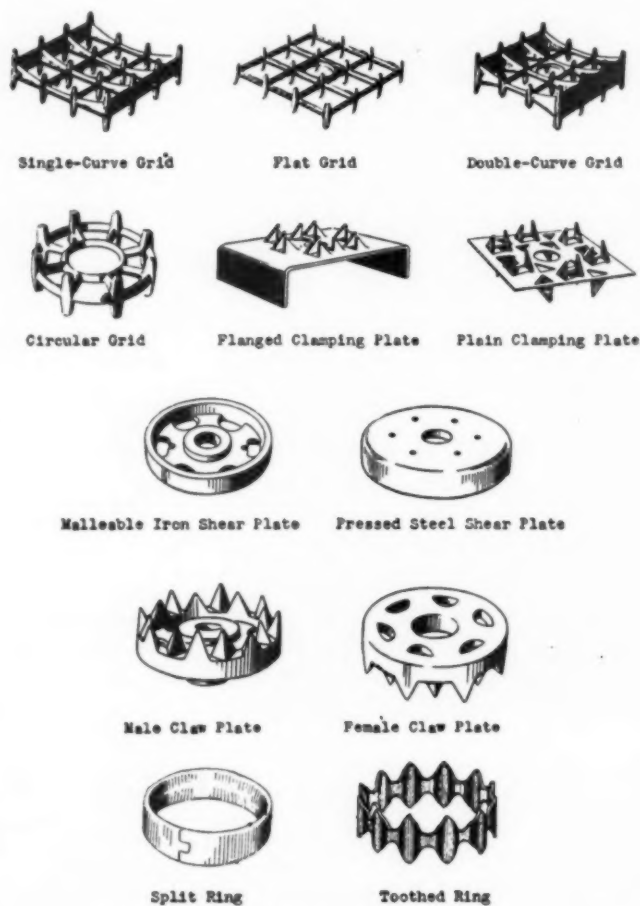
visions for detection, automatic extinguishing such as sprinkler systems, efficiency and availability of fire departments, accessibility of structure and water supply. Loss of life in building fires is seldom due to burns, but almost entirely is due to asphyxiation by gases and fumes or to panic.

Insurance underwriters who bet their money on the probability of fire loss recognize all this, and, for instance, have assigned to mill-type timber construction protected by automatic sprinklers insurance rates which compare favorably with so-called "fireproof construction." Frietag's Fire Prevention and Fire Protection states:

"One of the Mutual Fire Insurance Companies has estimated that a regular mill construction building is liable to be burned up once in every two thousand years."

Each of us who has kindled wood fires realizes that to get wood to burn successfully he must choose dry wood, chop the wood into fine pieces to obtain as much surface area exposed to the air in relation to its volume as is possible, provide a good draft, prevent the surface from charring deeply and prevent the wood from becoming wet. The simple facts we have learned there as well as others are considered in good fire-resistant construction.

Where maximum fire protection is desired, such as in large industrial buildings, the mill type of construction is used. This type includes structural members of large



Common Types of Modern Timber Connectors

section to minimize the exposed surface, various schemes such as encasing stairwells, installing fire doors and fire walls to minimize air drafts which are increased and

**More proof that abrasives
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Go Farther-Work Faster-Cost Less



Actual tests of unquestioned authority by state highway departments and engineering experiment stations show:

1. Skid resistance of $\frac{1}{2}$ lb. of calcium chloride treated abrasives is greater than $1\frac{1}{2}$ lbs. of the same abrasives untreated. Thus, you can save $\frac{2}{3}$ of your abrasives and at least \$6.60 per mile of 18-foot road by treating your abrasives with calcium chloride (at the conservative abrasive cost of \$1.50 per ton applied).

2. One cubic yard of treated abrasives will go three times as far—saves loading 2 out of 3 trucks when in a hurry.

3. Abrasives treated with calcium chloride bite right into the ice and give traction, while untreated abrasives are brushed away by tires and blown off by high winds.

4. Calcium chloride treatment prevents freezing of stockpiles, which are thus ready for easy loading and uniform spreading, impossible with frozen lumps.

This Standard Calcium Chloride Treatment Saves Money—Speeds Work—Promotes Safety

Stockpile treatment with flake calcium chloride (at a rate of 50 to 75 lbs. per cubic yard of abrasives) is standard practice in practically all states faced with the problem of skid-proofing icy pavements.

ICE CONTROL SUGGESTIONS FREE

Write for recommended practices and for data on field tests made by states, cities and experiment stations—but more important get calcium chloride into all your stockpiles now. Save $\frac{2}{3}$ of your grits—save $\frac{2}{3}$ of your loading—save picking away at frozen piles—save frostbitten fingers. Get speed into your safety work when ice starts to form, before wrecks occur, by treating all abrasives with calcium chloride.

CALCIUM CHLORIDE ASSOCIATION

4145 PENOBSCOT BUILDING • DETROIT, MICH.

followed by fires, and automatic sprinkler control to wet the fire and structure.

The National Board of Fire Underwriters report in "Fire Tests of Building Columns" that (in the standard fire tests in which furnace temperatures by means of gas blast burners reach about 1250 degrees F. at the end of ten minutes; 1550 degrees at the end of thirty minutes, and 1700 degrees at the end of one hour) a 12 ft. 8 in. unprotected 8 in.-34½ pound solid rolled steel H column carrying its design load of 119,500 pounds (11,750 pounds per square inch) failed by buckling in 11¼ minutes, whereas a 12 ft. 8½ in. unprotected 11¼ in. x 11¼ in. wood column with cast iron cap and pintle carrying its design load of 118,500 pounds (936 pounds per square inch) failed at 50 minutes due to cracking of the cast iron cap, thereby causing the pintle to split the column. The sides of the wood column at the end of the 50 minutes were charred to a depth of only 1¼ in.

Unlike metal, wood does not lose strength with increase of temperature. The wood loses strength only through loss of cross section. The charred surface of the wood retards the progress of the fire by acting as an insulator.

Although freshly creosoted lumber has less fire resistance than untreated lumber, after the lumber has seasoned some months the more volatile parts of the oil disappear from near the surface and the creosoted wood usually is but little, if any, easier to ignite than untreated wood.

Certain impregnations will render wood incapable of supporting combustion, but are quite expensive for general use. However, they have their place in such items as fire doors, certain types of scaffolding, and similar items.

The United States Forest Products Laboratory in its "Wood Handbook" states:

"Fire-retardant paints are of varying composition and properties but fall into two general classes; namely, special exterior paints usually made with an oil base or a binder, and interior paints, chiefly of the cold-water type (Prince). The cold-water paints, including sodium silicate, whitewash, and some casein products, are among the most effective fire-retardant coatings and are relatively cheap. Most of them, however, are nondurable in outside exposures and are suitable only for interior use," and:

"Effective fire-retardant coatings, properly applied, are of value in delaying ignition and checking the spread of flame originating from small sources. They are not nearly so suitable for protecting against high temperatures for a long time as are impregnation treatments."

The fact that wood burns has been exploited beyond reason as an argument against lumber as a structural material. For example, there has been criticism of the New York City Tenement Law which was put in force in 1900 and permitted wood joists, wood-stud partitions and wood lath in tenements up to six stories or 75 ft. in height. In 1930 a Subcommittee on Fire Statistics, Multiple Dwelling Law, in its report quoted the following statement from the Bureau of Fatality Statistics of the State of New York Tenement House Department:

"The records of deaths by fires in Tenement Houses includes deaths from all causes such as individual accidents, children playing with matches, re-entering or remaining in building to obtain possessions, paralysis from fright and other causes. There has never been a life lost by fire in a New York tenement

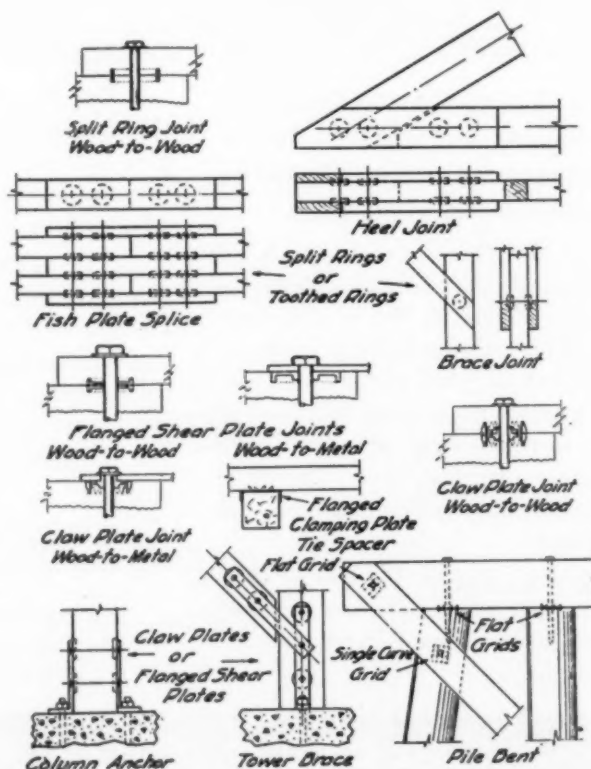
due to conflagration of the building or to any defect in the construction or arrangement of same."

This is a perfect thirty year record for 100 per cent of the buildings built under this law for 100 per cent of the time period of no fatalities from fire in the largest city of the western hemisphere.

Fastenings

In recent years remarkable improvement in the efficiency of structural fastenings for lumber has taken place. Of these, modern timber connectors and glue, both of which under certain conditions will develop the full strength of the member, are in the forefront. Durable water resistant glues which are as strong as the wood itself have been developed and applied in bow-string trusses, large span arches and structures utilizing the covering for carrying part of the load. Hence, wood structural members of practically any shape or size are possible. Information on the design and construction of wood arches is given in the "Glued Laminated Wood Arch" by T. R. C. Wilson, United States Forest Products Laboratory. Research by that laboratory and others have established accurate design loads for the older mechanical fastenings such as nails, screws, bolts and lag bolts, as well as for modern connectors.

Modern timber connectors are rings, plates, discs or dowels of metal or wood, placed at the contacting faces of overlapping members and partially embedded in each member by either pressure or insertion into pre-cut grooves. The connectors transfer most of the load between members, with the connectors and members being held in place by bolts. Plywood or metal gusset plates may be used in conjunction with connectors but they are seldom necessary. Various sizes and types of connectors for joining wood to wood, wood to metal, rectangular members to round members, and round members to round members are available commercially.



Simple Joint Details Illustrating the Use of Various Types of Connectors

READY TO DIG IN FOR AMERICA'S DEFENCE

Baker Tractor Equipment is ready for its important part in speeding up the defense program. Big Baker Bulldozers and Grade-builders, busy Hydraulic Scrapers and powerful Road Rooters are already diligently working on the sites of many great defense projects. Baker Snow Plows are waiting to clear the way for the transportation of materials so that precious winter hours may not be lost. For 32 years Baker has maintained a leading place in the industry. Now, when there is greatest need for its products, we are making every effort to provide equipment which builders for defense must have.

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THE BAKER MFG. CO.

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HYDRAULIC BULLDOZERS

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ROAD ROOTERS

SNOW PLOWS

GRADEBUILDERS

★ **BAKER TRACTOR EQUIPMENT** ★



Glued Laminated Wood Bow-String Trusses with Connector-Attached Web and Lower Chord Members, Spanning 60 ft., Spaced 15 ft. On Centers, and Located In A Super-Market at Helena, Montana

The use of connectors, which has revolutionized wood design and extended the use of wood into structural fields previously considered impractical for wood construction, permits the building of framed structures of practically any shape. The more than 12,000 lumber structures built with connectors within a 5-year period range from short-span roof trusses to roof arches of 125 ft. span, hangar trusses of 150 ft. span, arch bridges of 180 ft. span, truss bridges of 210 ft. span, ski jumps 165 ft. high, radio towers 326 ft. high, heavy falsework and underpinning. The accompanying drawings and photographs and those in an article entitled "Examples of Recent Timber Bridge Construction" in the October, 1938, issue of *ROADS AND STREETS* illustrate typical structures in wood.

Additional Information

Obviously in this short article only a few of the more important items can be generalized. Details of application must be omitted, and the reader should be referred to other sources for additional information.

A considerable part of the information given herein has been abstracted and summarized from technical publications of the National Lumber Manufacturers Association, Washington, D. C.—particularly, from "Wood Structural Design Data," Volume 1, and its seven supplements (available for \$1.25)—which are based on the research findings of the United States Forest Products Laboratory and others arranged for the convenience of the designer. These publications contain text material, formulas, basic data, computed safe load tables, and other useful data commonly desired by designers. Similar information is available from various regional lumber manufacturers associations.

Much of the research findings of the United States Forest Products Laboratory has been summarized in the "Wood Handbook" (available from the United States Superintendent of Documents, Washington, D. C., for 35c).

The above publications also contain bibliographies and references which will cover almost any subject in which the designer is likely to be interested.

Conclusion

Wood, which unlike other common structural materials is a crop and therefore a replaceable raw product, has inherent merits which deserve greater consideration by structural engineers than has been given generally. The more progressive technical schools are awakening to this fact, and are teaching modern scientific design in wood. The sound economical lumber structures which result therefrom serve the best interests of structural designers, contractors and manufacturers and owners, as well as those of the general public.

JUST A LITTLE HAULING JOB

Don't blame us for being road hogs; we're merely taking a culvert form up to the Redding Dam in California—a necessary job for several reasons. The con-founded thing is 60 ft. long, 18 ft. wide and 26 ft. high,



but we'll get it there in spite of curves, grades and bridges. If you look closely inside you'll find a Trailmobile carrying the load. The job is being done by The Thomas Rigging Co., who make a specialty of heavy and unusual hauling.

WORLD REGISTRATION OF MOTOR VEHICLES

Of the 45,422,411 motor vehicles registered throughout the world, 31,104,118 or over 68.5 per cent are in the United States. The following table from *Automotive World News* for May 20 shows the world registration of motor vehicles as of Jan. 1, 1931-1940:

Year	United States	Other Countries	World Total
1931.....	26,697,398	9,108,234	35,805,632
1932.....	25,986,353	9,277,044	35,263,397
1933.....	24,317,020	9,250,275	33,567,295
1934.....	24,057,027	9,505,032	33,562,059
1935.....	25,163,789	10,191,521	35,355,310
1936.....	26,382,321	11,072,488	37,454,809
1937.....	23,520,559	12,039,608	40,560,167
1938.....	30,041,292	13,037,338	43,078,630
*1939.....	29,942,316	13,877,613	43,819,929
*1940.....	31,104,118	14,318,293	45,422,411

* Including non-contiguous territories.

DISTRIBUTION OF TRAFFIC OVER ROAD AND STREETS SYSTEMS

Source: Public Aids to Motor Vehicle Transportation¹

Road System	Vehicle-Miles (1,000,000)	Per Cent
State primary highways.....	138,496.6	56.3
State secondary highways.....	5,289.2	2.2
County and other local roads.....	27,878.8	11.3
Urban streets.....	74,185.8	30.2
Total.....	245,850.4	100.0

¹ Supplied by U. S. Bureau of Public Roads for the entire country, 1936.

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licks winter's meanest jobs



Winter's toughest jobs are all in the day's work for WALTER SNOW FIGHTERS. Whether it's a case of punching a road through heavy snowdrifts, scraping hard-packed snow and ice down to bare pavement without damage to the road surface, spreading sand over danger spots, or what-have-you, you can count on WALTER FOUR-POINT POSITIVE DRIVE to see you through. And what is this famous drive? It's a matter of exceptional traction resulting from a combination of features found complete only in Walter Tractor Trucks. That means Automatic Lock Differentials, Suspended Double Reduction Drive, High Ground Clearance, Tractor Type Transmission, Superior Braking Capacity and other important points that give Walter Snow Fighters what it takes. Order Walter Snow Fighters now and be sure of open roads for your community this winter and for many winters to come.

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1001-19 IRVING AVENUE, RIDGEWOOD, QUEENS, L. I., N. Y.

STEEL REINFORCED BRICK BLOCK PAVEMENT GROUTED

Completed Road Laid Without Concrete Base or Side Curbs

By MORGAN P. O'BRIEN

*Civil Engineer
Springfield, Ill.*

OUT of experimentation and the trial of lesser areas, an installation of steel reinforced brick block pavement was built by the Illinois Division of Highways during the past summer. This stretch of 1.06 miles is of 22 feet and 33.5 feet in width. It is at the edge of the City of Springfield, Ill.

The surface consists essentially of vitrified blocks 8 in. by 8 in. by $3\frac{3}{4}$ in., laid flat, with $\frac{3}{8}$ in. steel reinforcement bars placed between the blocks and embedded in a Portland cement grout filler.

The longitudinal reinforcement bars are supported on lugs formed into the sides of the blocks. The transverse bars are supported upon the longitudinal rods. The blocks are spaced $\frac{3}{4}$ in. apart, leaving room for the mortar to flow freely and thus encase the reinforcing steel. As an additional precaution, and in order to secure better bond of mortar to blocks, the blocks are grooved longitudinally and the ungrooved portions are scored.

More Details

The pavement described was placed on South Grand Avenue and on Rochester Road, starting at Wheeler Avenue and connecting with the brick pavement on U. S. Route 66 By-Pass, otherwise known as the Springfield Belt Line. At the Wheeler Avenue end, a connection was made with the city brick pavement. From Wheeler Avenue an old 18-ft. grout-filled brick pavement, on a concrete base, had extended 2432 feet eastward to Rochester Road, an earth highway. All old bricks were removed, leaving the original concrete base in place. Upon the first 1000 feet, a new surface 33.5 feet wide, with combined concrete curb and gutter, was placed. A sand bedding course was placed over the old

base and new earth subgrade adjoining. The pavement was placed on this bed.

On the last 1000 feet in Rochester Road, a sand bed was placed upon a compacted earth subgrade, and the brick block pavement was laid upon it. In the 3700 feet between the above sections, a concrete bed, 2 in. thick, was laid upon the subgrade and, before initial concrete set, the Poston pavement was laid upon it, no sand bed being used.

Expansion joints consisted of premoulded joint filler, through which $\frac{3}{8}$ in. steel dowels, 15 in. long, extended into holes in the brick on either side. Expansion joints were placed at 50-ft. intervals. Dowels were coated with heavy oil to prevent filler adhesion and to permit free action due to expansion or contraction.

Construction

In order to supply the brick droppers, it was necessary to use eight laborers and some times nine. After the 1000 feet of 33.5 ft. pavement was laid, a roller conveyor was used on the 22-ft. width from brick piled on one road-side only. At the start two and, for a while, three droppers were used.

One of the droppers, Mr. Roy Swinford, who is well known to contractors and brick manufacturers in the Central West, devised and used an ingenious clamp attached to gloves on both hands. With this device he was able to lay as many or more than the combined result of other droppers who were not so equipped. As a matter of fact, before the end of the job he, alone, was dropping brick and at the rate of more than 1000 square yards per day.

The use of the conveyor cut the number of laborers



Dropping Brick Block Between Longitudinal Bars. Note Lugs on Side of Block for Holding Bars in Place



Showing Jig in Foreground for Keeping Steel in Place

New Gateway to the West . . . the Ben Humphreys Bridge



THE 3-SPAN CANTILEVER unit over the Mississippi River comprises two 640½-foot anchor spans and an 840-foot main span which includes a suspended span of 462 feet.

APPROACH viaducts consist of plate-girder deck spans supported on steel and concrete bents. Girder span lengths are: two of 218½ feet, two of 146 feet, twelve of 180 feet, sixty-two of 75 feet, and five varying from 53½ to 63½ feet. Cement for concrete roadway, was manufactured by the Universal Atlas Cement Co.

The Ben Humphreys Bridge was built for the City of Greenville, Mississippi. Milton C. Smith, Mayor. Ash-Howard-Needles & Tammen, Kansas City, Missouri, were the designing and supervising engineers.

TRANSCONTINENTAL motorists via U. S. Highway No. 82, no longer need ferry over the Mississippi between Greenville, Mississippi and Lake Village, Arkansas. Nor will they be concerned during high water, for the new Ben Humphreys Bridge will afford a 65-foot clearance over the highest flood level of this mighty stream.

Rising from road grade on either

bank, this modern steel structure, two miles long, accomplishes the crossing of the river by means of a 2121-foot cantilever structure of 3 spans. Flanking this cantilever unit, plate-girder deck-span viaducts extend to the levee lines on each bank. These approaches, with maximum grades of 4 per cent and horizontal curves up to 2 degrees, have respective lengths of 1958 and 6360 feet on

the Arkansas and Mississippi sides.

The superstructure carries a 24-foot reinforced concrete roadway with bent steel plate sidewalk curbs 18 inches wide. Some 10,700 tons of fabricated steel, including steel railings, entered into this construction. American Bridge Company not only furnished and erected all steelwork but contracted as well for the finished concrete roadways.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.



Baltimore • Boston • Chicago • Cincinnati • Cleveland • Denver • Detroit • Duluth
Minneapolis • New York • Philadelphia • St. Louis

Columbia Steel Company, San Francisco, Pacific Coast Distributors • United States Steel Export Company, New York

UNITED STATES STEEL

to five, two of whom placed blocks on the conveyor and three who placed them for the dropper.

It was demonstrated that the rate of road production per day is, to a certain extent, dependent upon the speed with which the bedding course is prepared. Where there was no delay from this course, blocks were laid at the rate of one per second, or more than 1400 square yards per eight hour day, using one brick dropper and five laborers.

Considerable exploration for better methods was done in the matter of placing steel. It was found that by placing the rear ends of the longitudinal bars between rows of blocks and carrying the mover a "jig," pushed ahead on edge forms as laying progressed, the bars would act as liners and spacers. Transverse bars were laid on the horizontal ones and pulled back into position upon completion of a course of blocks.

In another plan a steel grid, containing thirty transverse and three longitudinal spaces, was suspended from forms ahead of the work. Blocks were dropped into the grid spaces and bars were placed by hand. In the latter method about four man-hours per day were needed to place reinforcement.

For mixing and placing mortar, a small mixer and rubber-tired carts were used. The carts were run on plywood runways, laid on brick surface, and were dumped on the surface of the blocks. The mortar was then spread by the use of squeegees. The crew consisted of a mixer operator and from five to eight laborers, depending upon the length of haul.

The material required for mortar was 0.0508 barrel of cement and 0.0327 ton of sand per square yard. For each bag of cement $9\frac{1}{2}$ gallons of water were used to provide sufficient fluidity to fill joints and to cover the reinforcing bars. Despite the unusually large amount of water, there is no noticeable slump in the joints.

Before filling, the surface was straight-edged and blocks were adjusted, where necessary, to bring the surface within the Illinois Division of Highways tolerance of $\frac{1}{8}$ in. in 10 feet.

Additional Information

In the manufacture of the vitrified blocks, two radical departures from what has been considered to be standard procedure were made. Instead of the customary vertical fiber, these blocks were made with fiber running horizontally, in an effort to minimize edge spalling. To provide additional toughness under traffic, the upper surface of the blocks was given a wire-brush, non-skid finish.

Calculations which have been made show a low cost for high strength.

The experimental section of this pavement was placed in 1931. Concentrated tests failed to perceptively affect it. An excavation was made under the pavement. There was no substantial difference in test results after the excavation was made. The section has withstood heavy brickyard traffic.

The pavement requires only a graded earth base and a thin sand cushion course. Close check has been made of construction costs by this writer, and the figures indicate that this installation was completed at a total cost comparable with other pavements of equal durability.

It is noteworthy that, after grading, no large machinery is required to build the brick block pavement.

The work of laying brick was started on August 13, and the last blocks were laid on September 16. The entire road was opened to traffic the last week in September and has carried heavy traffic since that time. The plant of the Poston-Springfield Brick Company, manufacturers of the blocks used in the project, is located

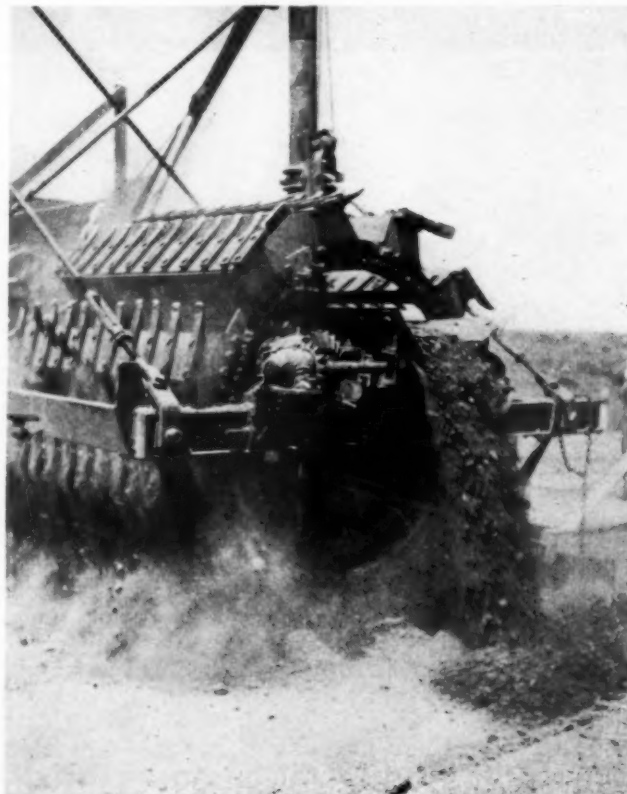
midway on this pavement stretch, and all shale used in the brick plant is hauled in trucks from the shale pit over this new road. These heavily loaded trucks, moving at the maximum legal speed, use the new pavement constantly, and have done so since its completion. It is particularly interesting to note that their routing takes them over the east part of the project, which includes 1000 lineal feet, where there is no support other than subgrade, and 2180 lineal feet where a 2 in. concrete bedding course, laid on subgrade, was used.

The contractor was the Sangamo Construction Company of Springfield, Illinois, and Charles M. Slaymaker, District Engineer, Illinois Division of Highways, was in general charge for the state.

AN EXAMPLE OF THE USE OF HARD FACING ON ROAD WIDENER TEETH

It is reported from a western state, where the accompanying picture of a road widening operation was taken, that the effective life of teeth on the machine was greatly lengthened.

The job involved the cutting down of a 4-ft. strip of compacted gravel shoulder on each side of a 2-lane pavement, preparatory to widening it to 3 lanes; and because of the character of the material, tooth sharpen-



Hard Service for Road Widener Teeth on Model 16R-4 Buckeye Highway Widening Machine

ing and replacement raised a little economic problem all their own.

This problem was solved by facing them with a self-hardening chromium-molybdenum-high carbon alloy with a Brinell of 450 to 550, after which the teeth gave approximately three times as many miles of service before requiring sharpening or retreatment. The machine, a Buckeye, had 110 teeth—11 rows of 10 each—the dimensions being $1\frac{1}{2}$ in. wide, $\frac{3}{4}$ in. thick, and 10 in. long. The facing material was Amsco Economy Hard-face rolled rod.



Calling all Concrete Men to the Concrete Industries Exposition

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The *only* major concrete machinery exhibition
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of concrete equipment design. All kinds of new
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Come and mix with the boys, and see these units
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profits in what promises to be a boom construction year.*

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officials—this is **YOUR** show! Plan now to attend.



Held concurrently with the annual conventions of
 National Concrete Masonry Association
 American Concrete Contractors Association
 National Cinder Concrete Products Association
 American Concrete Pipe Association
 Cast Stone Institute Illinois Builders' League

LIBRARY SYSTEM

For Engineers and Highway Departments

By LESLIE WILLIAMS

*City Planner and Traffic Engineer
Yale Bureau for Street Traffic Research*

CHANGING conditions of society as effected by improved means of individual transportation have broadened the field of activity of highway departments.

The rapidly expanding nature of the new activities necessitated the addition of a planning unit whose primary function is the assembly, analysis, and interpretation of data to reveal the practicability of proposed improvements and their economic and social justification.

This unit, to be most effective, must set up some system of classifying and arranging its data for ready reference; however, to avoid duplication of studies and to fill a long felt need of all the units of the highway department—Planning, Design, Construction, Maintenance, Traffic and Safety—the following Library Classification System for highway engineering materials is suggested.

Its scope is determined by the new activities of a planning nature, but the approach is from a traffic or operations point of view.

In reviewing the field for a sequence of headings which were orderly and yet comprehensive the *Accident* problem permeated throughout and loomed most prominent with emphasis on the *Driver* and *Pedestrian*, their *Education* and the formulation of *Rules* of conduct on the road followed by *Enforcement* and the *Courts*. Paralleling this aspect was an accumulation of information on *Traffic Equipment*, *Highway Lighting* and *Techniques* of studying highway problems. Coincident with the growth in mileage of paved roads in rural areas and the increased urban congestion and decentralization focused upon *Highway Engineering*, offstreet *Parking* and regional *Planning*. These aspects necessitated consideration of other forms of *Transportation*, *Economics* and *Taxation*. Finally, there was the interest in the safety features of the *Motor Vehicle* and the *Organization* and *Administration* of street and highway departments to meet the broadening field of activity.

An alphabetical plan of classifying materials was selected. This plan not only covers the present main headings and leaves room for expansion but also fulfills the specialized terminology of the various department units and permits filing of overlapping materials by one without previous library experience.

As presented it is neither all-inclusive nor so broken down into subheadings as to hamper adjustment to local needs or to individual desires.

It is hoped, through the establishment of this simple Library System, that each unit of a highway department will more easily keep abreast of new developments and that each individual engineer will be encouraged to continue his education and thereby derive a greater satisfaction in the practice of his profession.

Real credit for this alphabetical system of classifying materials should go to Mr. Joseph R. Wright, now librarian for the Littaur School of Public Administration, Harvard University, who brought the system to the writer's attention.

The author has already organized a similar classification for the traffic engineer which is suited to the specialized nature of his field and is operating satisfactorily.

The library system consists of three elements: Classification Plan, Subject Index and Topical Index together with instructions for the use of each.

Classification Plan for Publications, Plans, Photographs, Sketches, Maps, Etc.—This sorts all materials pertaining to highway improvement into 16 broad functional classes with numerous subheadings, and a capital letter is applied to each broad heading with numerals for the subheadings.

It would appear at first glance that the alphabetical plan would be too limited to provide for expansion of a growing field; however, as comprehensive a field of study as is possible at the present time for highway engineering literature has been included in this system with sufficient room for expansion for some time to come. When all letters of the alphabet have been used, a system of double letters (AA) is possible. The numerical system can also be expanded by decimals. The chief values of the Classification Plan are that it gives a clearer picture of the whole field and also provides a method of grouping all publications on specific subjects in a permanent location on shelves in a logical and clear-cut fashion.

FUNCTIONAL CLASSES

- A—GENERAL
 - B—ACCIDENTS (General)
 - D—DRIVER AND PEDESTRIAN
 - E—PUBLIC EDUCATION
 - G—CODES—ENFORCEMENT—COURTS
 - H—TRAFFIC EQUIPMENT AND DEVICES
 - J—LIGHTING (Street and Highway)
 - K—TECHNICAL PROCEDURES
 - L—STREET AND HIGHWAY ENGINEERING
 - N—PLANNING
 - P—TRANSPORTATION
 - R—ECONOMICS
 - T—TAXATION
 - V—VEHICLES
 - Y—ADMINISTRATION AND ORGANIZATION
 - Z—PERIODICALS AND MAPS
- (NOTE: Letters omitted for expansion.)

Manual of Instructions

Inspect thoroughly the *classification system* before attempting to arrange publications or to begin a card cataloguing system. Familiarize yourself with the subdivisions of each main class. This will save time and effort later.

Set up a system for publications first, then it will be seen that plans, maps, photographs, etc., will fall easily into this scheme. Cards can then be typed and filed for other materials according to subject.

Classifying of Publications.—Begin classifying by sorting publications according to the main headings specified in the classification system.

Consider the main subject matter of the book first and place it in the proper class. Be sure not to place a publication in the *A-General* class unless its contents

A NEW COST DATA BOOK

Outline of Contents

CHAPTER 1. INTRODUCTION—Brief discussions of construction costs, prices, profits and the uses of cost data.

CHAPTER 2. COST INDEXES—Indexes of the U. S. Public Roads Administration and Interstate Commerce Commission, with brief explanations of their construction, uses and limitations.

CHAPTER 3. OVERHEAD COSTS—Separate discussions of the overheads incurred by contractors and by states, counties and cities.

CHAPTER 4. ENGINEERING—Data from states, cities and other sources on the costs of various kinds of surveys and other engineering. There are brief articles on aerial surveys and seismographic soil and rock surveys.

CHAPTER 5. RIGHT-OF-WAY—A general discussion followed by records of actual experience and costs.

CHAPTER 6. EQUIPMENT—This chapter contains several rental and ownership expense schedules in full detail, followed by articles on operating and maintenance costs, including records of fuels, lubricants, etc., a mathematical analysis of the problems of selecting and retiring machines, and a table of depreciation rates.

CHAPTER 7. LABOR—Schedules of established minimum wage scales and records of wage rates in various states; comparisons of contract work and day labor; convict labor costs and other pertinent matter.

CHAPTER 8. CLEARING AND GRUBBING—Records of clearing with tractor-mounted equipment, hand and horse methods, stump blasting, etc.

CHAPTER 9. GRADING—Eighty-four pages of articles on grading with power shovels, scrapers of various types and sizes, elevators, blade graders, bulldozers, etc.; hydraulic grading; rock drilling and blasting; winter grading; special swamp grading; minor operations and hand work.

CHAPTER 10. HAULING AND HANDLING MATERIALS—Studies of hauling operations on power shovel jobs, concrete construction and bituminous construction; truck movements at yards; industrial railways; team and wagon hauling; and other articles.

CHAPTER 11. PRODUCTION OF AGGREGATES—Articles on labor requirements and costs of producing sand, gravel and crushed stone at various locations.

CHAPTER 12. UNTREATED BASES AND SURFACES—Waterbound macadam, crushed rock and gravel construction.

CHAPTER 13. STABILIZATION OF BASES AND SURFACES—This chapter is devoted chiefly to work with calcium chloride, articles on portland cement and bituminous stabilization being given in the chapters on concrete and bituminous construction.

CHAPTER 14. BITUMINOUS SURFACES AND BASES—The five parts of this long chapter contain articles on various methods in different states. Part 1, Surface Treatments; Part 2, Bituminous Macadam; Part 3, Mixed-in-Place Construction; Part 4, Traveling Plant Construction; Part 5, Stationary Plant Construction.

CHAPTER 15. CONCRETE SURFACES AND BASES—Contains numerous detailed records of construction. There are articles on work with 27-E pavers, 34-E pavers, tandem set-ups, batching, hauling, curing, joints, cement-bound macadam, soil-cement roads, stabilization, and other subjects.

CHAPTER 16. BRICK PAVEMENTS—Records of brick pavement construction from various cities and states, including an article on vibrated monolithic. Short references to granite block.

CHAPTER 17. SIDEWALKS, CURBS AND GUTTERS—Miscellaneous prices and details of construction.

CHAPTER 18. WALLS, FENCES AND GUARD RAILS—A brief chapter of data on these items of highway construction.

CHAPTER 19. BRIDGES AND CULVERTS—Cost data on a large number of steel, concrete and timber bridges and grade separations—also culverts of various types. There are two articles on pump installations for underpass drainage.

CHAPTER 20. TUNNEL CONSTRUCTION—Detailed descriptions and data on the construction of 27 highway tunnels in the West.

CHAPTER 21. GRASS, SHRUBS AND TREES—Several articles on plantings for landscape improvement and bank protection.

CHAPTER 22. MISCELLANEOUS—Data on pedestrian underpasses, street car loading platforms, truck weighing stations, catch basins and manholes, lignin binder, water pumping, signs and markers, traffic striping, parking meters, highway lighting, radio communication with snow plows, accident prevention, and weather and construction.

INDEX—Unusually complete; arranged for quick reference and maximum convenience.

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BY

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AND

JOHN C. BLACK

This book was planned and compiled expressly for use by contractors, engineers and highway officials.

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In general the data are of two main classes—dollar and cents costs per mile, per square yard, per cubic yard, and the like, for use in quick approximate estimates; and details of material, labor and equipment costs, with records of man-hours and machine-hours, for use in close estimating and in studies to reduce costs or improve methods.

The data are from a great number of different sources, and are in widely varying detail.

All major articles carry descriptions to show clearly the class of work and the methods for which costs are given, and to provide a basis for further reference and study if desired.

Location and date of job and the source of information are given in the title and introduction to each article.

The grouping of subjects in chapters is convenient, but an unusually complete index is furnished as the main guide to any subject or sub-subject sought.

The authors are both men of practical experience in highway and other construction. Both are members of the American Society of Civil Engineers.

The book is filled with useful data, and its answer to just one question may easily be worth hundreds of times its price.

The outline in the adjoining column indicates the general scope of contents.

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are comprehensive. Example: Highways and Highway Transportation by George R. Chatburn should be placed in the *A group*; but materials pertaining to a particular aspect of the field, such as "Traffic Fatality Comparison, 1937-1938," by State Motor Vehicle Department, Hartford, Connecticut, should be placed in the *B Accidents* class because it covers accidents in general. However, the publication, "Pedestrian Protection," issued by the American Automobile Association in 1939, would be placed in class *D-Driver and Pedestrian* because it deals specifically with pedestrian accidents and protection.

When all publications have been divided among the main classes, break each class into subdivisions. Using class *B-Accidents* as an example, subdivide as follows:

- B1 Comprehensive publications and Bibliographies
- B2 Causes (How and Why)
- B3 Alcohol
- B4 Location (Where)
- B5 Time
- B6 Types
- B7 Statistics (Reports, Bulletins)
 - B71 City
 - B72 State
 - B73 National
 - B74 Foreign

During this process assign to each book the proper class letter and numerals, which combination will henceforth be referred to as the 'book number.' This book number should be written on the front cover, preferably in the lower left-hand corner for convenience in finding. It is also suggested that the book number be indicated on the back of the title page for ease of identification should the cover be torn or lost.

NOTE: Pamphlets or clippings not important enough to catalogue should be given the proper *class letter*, filed in a pamphlet box so marked, and placed on the shelf at the beginning of the class. It may also act as a division between classes. Pamphlet boxes made of cardboard and open at one end are satisfactory and cheap. A 13-inch box will carry most loose material (note size of shelves). Other pamphlets or clippings can be glued or stapled in folders (manila). There is a considerable amount of this loose material in the field.

All publications are by now arranged in main classes according to the system and each publication has its correct book number. Next, take all references with the same book number and arrange alphabetically by author with the exception of materials of political subdivisions which are filed alphabetically by place: See A7—Surveys.

Finally, place a label with class letter and its descriptive term on the shelf.

Cataloguing of References.—A complete indexing system would contain, among others, Author and Subject files. This point has been given serious consideration, and it is the opinion of the author that a Subject file will work satisfactorily.

The Subject file is an alphabetical card catalogue with individual references filed behind each subject as for example, all articles on grade separations would be filed alphabetically by author in the *G's* behind the subject heading: Grade Separations.

A list of Subject Headings is submitted to guide the reader in getting up a Subject card file. The italicized headings in the list if typed on the tabs of blue or orange index cards will make an obvious separation of the cards in the catalogue.

The 3 in. by 5 in. plain white filing cards with subject, author, title, date, call number and other typed information are filed back of their respective index cards in alphabetical manner.

Additions to the classification plan can be made more

easily if the plan is typed on 8½ by 11 in. sheets and kept in a looseleaf notebook.

Explanation of Library Cards and Symbols.—Figures 1 to 3 and notes show the usual layout and spacings for articles as separate publications by an individual

Economics - State-aid

- B42 Butler, Prof. J. B.
State-aid for Missouri Roads
American Roadbuilders' Association Convention
Proceedings, 1940. pp. 580-618

Notes: Discussion of policy with appendices and tables. It includes letters and statements of officials on state-aid proposals and allocation.



Fig. 1.—Periodical or Proceedings

Street and Highway Plans - Regional

New England Regional Planning Commission
National Resources Committee; Region I

- H32 A Highway System for New England
Publication No. 54, Sept. 1938; 34 p
Federal Bldg., Boston, Mass.

Notes: Shows the coordination of highways in N.E. with the resources and needs of the area. Maps are included showing different types of routes.



Fig. 2.—Separate Publication, Organization as Author

Curves - transition

- H412 Barnett, Joseph
Transition Curves for Highways
United States Dept. of Agriculture
Bureau of Public Roads, U. S. Government Printing Office. 1938; 211 p. 60¢

Notes: Treats of speed in relation to highway design safe speed on curves, maximum curvature for various design speeds, etc., and design of curves by use of tables.



Fig. 3.—Separate Publication, Individual as Author

author or an organization and when published in a periodical.

Other Traffic Materials.—Figures 4 and 5 suggest a means of keeping a record of other traffic materials such as photographs, slides, maps and charts which are stored in other places than on the shelves with the books, but cards for which are placed in the subject file.

NOTE: The use of different colored cards for photograph and map files will facilitate identification in catalogue.

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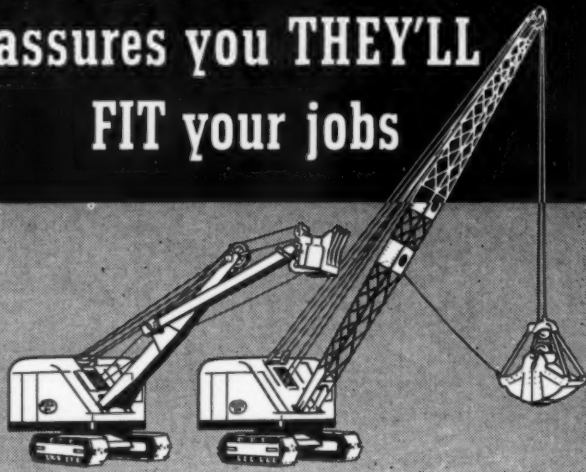
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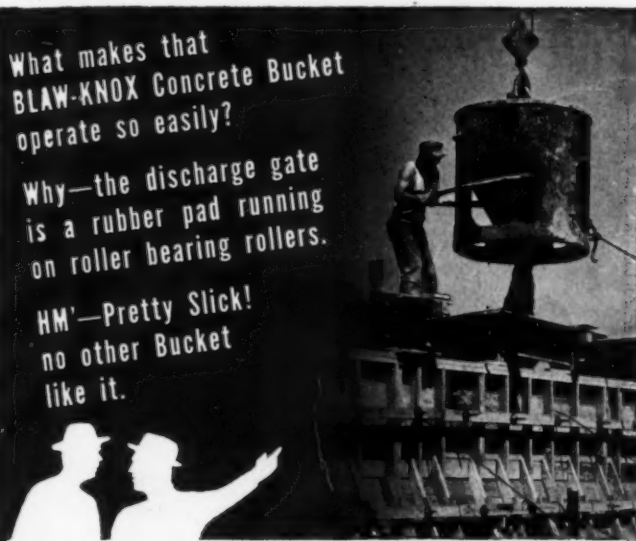
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Subject Index

This is a record on cards of all individual books in the library, their location on shelves, and the existence of articles on specific subjects in periodicals and proceedings. It also provides an easy and workable method of finding all materials. This subject index provides for main subject headings to be typed upon the tabs of colored cards as a guide in using and as an obvious division of the catalogue. Other headings than those listed here may be used to serve the purpose of the individual office or engineer. The headings selected were taken from the point of view of a Traffic Engineer's Office. These index cards are filed alphabetically, and the usual white filing cards are filed alphabetically behind their respective index cards. A Traffic Engineer's Office partial list of Subject Headings might be as follows:

Intersections - Photographs	Photo File 1549
Sacramento, California	
"Y" intersection to be channelized: dangerous - heavy flow; Route 40.	
Taken 11 AM, July 24, 1939. Size 8" x 10"	
Notes: Flow 12,000 on each street per day. Asphalt surface, 4 lanes; mixed, fast suburban traffic. Exposure f:4.5 Speed 1/100 Kotochrome	

Fig. 4.—Photographs and Slides

Volume - Maps	Map File 73
San Francisco, California. Dept. of public works.	
Vehicular flow. Jan.-June 1937: 17" x 22"	
Notes: Field check, Jan., Feb., March, April, May, June 1937. All flows are typical weekday 12 hr. counts from 7AM to 8 PM.	

Fig. 5.—Maps and Charts

ACCIDENTS

Accidents
Accidents—Analysis
Accidents—Bibliography
* Accidents—Cities
see Accidents—Statistics

Accidents—Location
* Accidents—Night
see also Lighting
* Alignment—see Streets and Highways Alignment

AUTOMOBILES

Automobiles
Automobiles—Brakes
Automobiles—Headlights

* Automobiles—Licensing
see Driver—Licensing
Automobiles—Registration

Topical Index

This is in reality all of the terms in the Classification System plus all others in general use by the Highway

* All headings starred require reference cards in addition to the regular references to publications which are filed after them. Reference cards are placed in the Subject Catalogue to refer one to another place in the catalogue where the sought for references are usually filed.

Engineer arranged alphabetically. Each term is given a class letter and number corresponding to the Classification System. This makes it easy for the librarian to find out where a new publication goes on the shelves and where its subject matter is classified in the library scheme.

Example.—A new publication on *Accelerating and Decelerating Lanes* is received. Instead of looking through the Classification System for these terms, one looks in the Topical Index under the A's and sees that Accelerating and Decelerating lanes is L423, which means that this subject is filed under *Street and Highway Engineering* in the group on *Design* under the term *Lanes*. A book number is then written on the publication and a catalogue card typed. The publication is then placed in its proper place on shelves and the card is filed in subject index under *Streets and Highways—Lanes*.

Anyone very familiar with the Classification System will not need this aid in filing new materials; however, a sample sheet of most of the terms beginning with the letter A is offered as a guide in forming the Topical Index.

TOPICS	CALL NUMBERS
Abutments	L52
Accelerating and Decelerating Lanes	L423
Accident-prone Drivers	D23
Accidents (general)	B1
Accidents—Bibliography	B1
Accidents—Causes	B2
Accidents—Cities	
Location—Urban	B41
Statistics	B71
Accidents—Facts	B7
Accidents—Foreign	B74
Accidents—History	B11
Accidents—Investigation	G3
Accidents—Location of	B4
Accidents—Night	B5
Accidents—Records	B7
Accidents—Reporting	B8
Accidents—Speed	B21
Accidents—Statistics	B7
Accidents—Surveys	B7
Accidents—Time	B5
Accidents—Types	B6
Accidents—Violations	B22
Accidents—Weather	B52
Adjudication (court decisions)	G6

Functional Classes

A—GENERAL

A1—Bibliographies, directories, indexes, rosters	A6—
A2—Organization proceedings, yearbooks, bulletins, constitutions, etc.	A7—Highway traffic surveys (general comment)
A3—International highway reports (Pan American, etc.)	A71—City and metropolitan
A31—United States highway reports	A72—County and state
A32—Foreign government reports	A73—United States and foreign
A4—City, state and county highway commission reports (Public Works)	A74—Specific studies
A41—Reports of Canadian provinces and of similar subdivisions of foreign countries	A741—Traffic volumes
A5—State motor vehicle department and traffic commission reports (Departments of public safety)	A742—Speed
	A7421—Speed and delay
	A7422—Spot speed
	A7423—Approach speeds
	A743—Origin and destination
	A744—Cordon counts
	A8—General works on streets and highways
	A81—Historical

CROSS REFERENCES:

Financial inventory—see	R2
Parking surveys—see	N812
Pedestrian surveys—see	D7
Road inventory—see	L2
Basic data—see	N5

B—ACCIDENTS

B1—General—Bibliography	B5—Time—Season—Weather
B11—History	B51—Night
B2—Causes	B6—Types
B3—Alcohol	B7—Statistics—Surveys—Facts
B4—Location	*B71—City statistics
B41—Urban	*B72—State statistics
B42—Rural	B721—Safety bulletins, releases
B43—Railroad grade crossings	*B73—National
B44—Intersections	*B74—Foreign
B45—Straightaway	B8—Reporting and record filing
B46—Curves	
B461—Horizontal	
B462—Vertical	

CROSS REFERENCES:

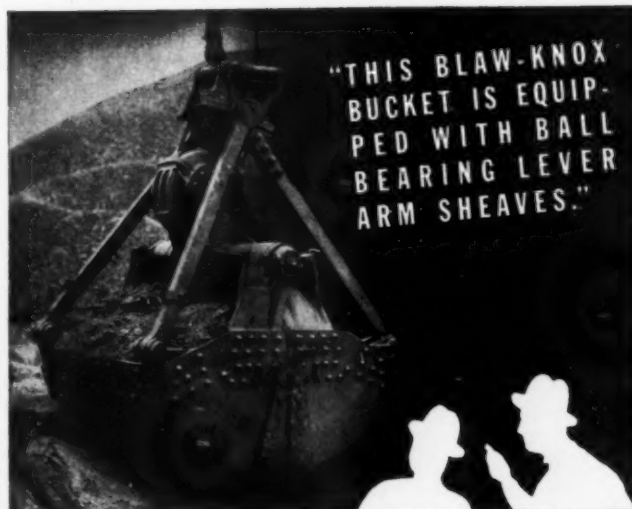
Driver accidents—see	D2
Pedestrian accidents—see	D2
Vehicle accidents—see	V11
Highway lighting—see	J4



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EDITORIAL

TRIALS OF THE AIRPORT BILL

DEVELOPMENT of aviation was recognized by the federal government as a growing industry as well as an arm of national defense when it created the Civil Aeronautics Authority, now the Civil Aeronautics Administration. The first real federal appropriation for development of civil airports resulted from H.R. 10539. It had a somewhat stormy career in its travels from introduction as a bill to its passage as an act.

As originally introduced and passed by the House of Representatives, H.R. 10539 contained an item calling for a cash appropriation of \$40,000,000 of which \$3,000,000 was to be used for general administrative purposes, and a contractual authorization of \$50,000,000 for development of landing areas of civil airports in the United States. None of these funds were to be spent for the purchase of land or the construction of buildings or hangars, unless certified by the Secretary of War and the Secretary of the Navy as being essential for military purposes.

As originally drafted, the measure met with the approval of the Appropriations Committee of the House of Representatives and was passed by them. The bill then went to the Senate where it was referred to the Committee on Appropriations. The Senate committee held hearings on the bill. Mr. Robert Hinkle, formerly Chairman of the Civil Aeronautics Authority, now Assistant Secretary of Commerce, presented testimony in support of the appropriation. After the Senate committee hearing, the bill was returned with every cent for airport development stricken from it. The action astonished those who realized the importance of federal aid appropriations for civil airport development as an aid to national defense.

On Thursday, Oct. 3, the bill was considered on the floor of the Senate and the Congressional Record of that date shows that Senator O'Mahoney of Wyoming and Senator Hayden of Arizona were among those who were evidently in favor of the appropriation. Earlier in the week the newspapers of the country had published a list of nearly 4,000 airports that were supposed to have been the program for the expenditure of this \$80,000,000. This is a good example of where publicity on incomplete plans nearly wrecked a needed program. Senator Hayden on the floor of the Senate on Oct. 3, said, "What the Civil Aeronautics Administration was seeking to do was to point out to the Congress a broad program which might take 5, 6, or 10 years to carry out. The money proposed to be appropriated in this bill would be a start. It would fit into a broad general program." Senator O'Mahoney offered an amendment from the floor that would have started the restoration of the appropriation in the bill; but the amendment was rejected. The bill, then, as referred to the Senate by its appropriations committee was passed with no funds for an airport program.

Next day the bill went to a Conference Committee of the House and the Senate. This group restored an appropriation in the bill in the amount of \$40,000,000. The Conference Committee report was, later that day, adopted by both the House and the Senate.

The 4,000 airports mentioned by the press were those being studied for possible inclusion in a broad development plan. They were all civil airports and in no way indicated any priority listing. The estimated cost for developing them would be approximately \$526,000,000 for construction only.

Of the \$40,000,000 which was finally passed, \$3,000,000 must be used for general administration. By recent conference it has been decided that at least \$35,000,000 of the remaining \$37,000,000 will be spent by contract through the division and district engineers of the U. S. War Department.

These results, through the face of the cold type, do not tell much. However, it should, in all fairness, be stated a great deal of individual effort and attention to the details of legislative manipulation was required by the backers of the airport development legislation in order to bring the results into being.

Late in the fall of 1939 the American Road Builders' Association formed its Airport Division. Since that time it has worked closely with the National Aeronautics Association and other organizations interested in aviation and necessary airport development on a coordinated basis. The bill which was passed last October is the result of this cooperative effort and the interest that was engendered in aviation by the introduction in Congress of other bills.

This recitation of the movements of the airport bill illustrates the necessity and value of a common plan, and how concerted individual effort turned defeat into victory.

INFORMATION PLEASE!

IN THE last two issues of *ROADS AND STREETS* I promised to tell you of a meeting to be held in New York of particular interest to contractors. This meeting will take place during the annual convention of the American Road Builders' Association at the end of next January.

The new federal tax bills will be explained and also some tips on how to reduce your compensation payments. A panel of experts including lawyers, will sit, after the plan of "Information Please," to answer knotty questions and clarify the new laws. Furthermore, the WPA contract management agreement will be explained by a contractor who has profited under the arrangement.

It behooves all highway and airport contractors to be present.

Sessions will be held in the Pennsylvania Hotel.

Furthermore, the new Depreciation and Rental Schedule for equipment will be presented and discussed.

The January, 1941 A.R.B.A. convention will be one of the best in the history of the organization. You cannot afford to miss it.

TEST GILLETTE'S THEORY

IN THIS issue Mr. H. P. Gillette suggests that destruction of the Tacoma Narrows bridge might be due to a pendulistic period for the structure harmonic with cyclic gusts of wind. This theory could easily be tested by suspending a pendulum of about the length of the calculated pendulistic period of the bridge, and find whether or not it vibrates in a gale or even in an ordinary wind. The pendulum could consist of a heavy sheet-iron bob suspended by a steel wire the length of which could be altered by passing it over a pulley at the top.

The test, naturally, would have to be made in the area near the bridge.

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NEW EQUIPMENT and MATERIALS

International Announces Five New Truck Models

Of special interest to users of light-delivery and light-duty trucks ranging in rated capacities from $\frac{1}{2}$ to $1\frac{1}{2}$ tons is the announcement of International Harvester's new line of five models in that capacity range. The new Internationals are: the $\frac{1}{2}$ -ton Model K-1, $\frac{3}{4}$ -ton Model K-2, 1-ton Model K-3, $1\frac{1}{4}$ -ton Model K-4, and the $1\frac{1}{2}$ -ton Model K-5. Wheelbases range from 113 to 177 inches and gross vehicle weight ratings from 4,400 to 13,500 pounds.

Outstanding among many important mechanical features of the new Internationals is the new "Green Diamond" engine which, in three sizes, powers the five new models.

International also announces new and highly efficient hydraulic brakes on all of these models. Two-shoe, double-anchor-type brakes provide greatly improved braking ability for trucks of the various sizes. On the larger-capacity units, Models K-4 and K-5, an entirely new, but fully proved, type of rear wheel brake (the new "Hi-Tork" brake) is employed. These new brakes



New International Model K-5 with all-steel welded dump body

have many outstanding advantages, including more nearly equalized brake-shoe pressure which results in longer lining and drum life, increased brake efficiency, reduced maintenance costs, simplicity of design, minimum number of parts, and easy adjustment features.

In these new Internationals are other quality features of design such as full-floating rear axles (except in the $\frac{1}{2}$ -ton and $\frac{3}{4}$ -ton models), roller bearing anti-friction universal joints, improved self-aligning propeller shaft center bearings in the long-wheelbase chassis, rubber-cushioned three-point engine mounting, rubber mounted radiator, sealed beam headlights, mechanical shift starter, oil bath air cleaner, sturdy truck-type clutches and transmissions, and two-speed rear axles in $1\frac{1}{4}$ and $1\frac{1}{2}$ -ton models.

New "Engine-Over-Drive" Motor Grader by Adams

J. D. Adams Company, Indianapolis, Indiana, has announced a new low-priced "engine-over-drive" motor grader in Adams Motor Grader No. 201. It is powered by an International 31 hp. engine and is ca-

pable of building and maintaining streets and roads from bank to bank, including light backsloping.

This new grader is built around an all-welded, box-type main frame originated



Adams New Engine-Over-Drive 201 Motor Grader

by Adams several years ago and now in use in all other Adams motor graders and leaning wheel graders. This type of frame, it is claimed, offers unsurpassed strength and rigidity, unhampered visibility of the blade from the operator's position, and an extremely wide range of blade positions.

Operating advantages claimed by the manufacturer are:

Fully power controlled, the No. 201 can be operated from the operator's platform in either a "stand-up" or "sit-down" position.

Circle is full revolving and blade can be set to ditch or move dirt with machine operating in reverse gear. Blade can be reversed with scarifier on machine by simply lifting scarifier teeth out.

The No. 201 has five forward speeds (with a high top speed of approximately 13 mph. for traveling), and one reverse speed.

The wide range of blade adjustments in all directions, single rear tires, and leaning front wheels, permit this grader to be utilized on all types of surface, ditch and bank work within its weight and power range. Standard equipment includes 10 ft. blade. Approximate weight with leaning front wheels is 9,000 lb. Optional equipment includes scarifier, canopy top, cab enclosure, starting and lighting equipment, etc.

Prices and literature can be had on request addressed to J. D. Adams Company, Indianapolis, Indiana, or their local distributor. Get Form No. 4019.

Shunk Makes Saw Tooth Blade

Hard packed snow and ice which make roads dangerous in winter may be removed from road surfaces by maintenance crews, with equipment on which is installed the newly patented Saw-Tooth blade now being manufactured by the Shunk Manufacturing Company, Bucyrus, Ohio.

The Saw-Tooth blade can be installed in place of the regular blade on any type of maintenance or snow removal equip-

ment without any other change in the machine. Because of its "pickaxe" action, this blade cuts through where a conventional type of blade rides over.

One trip over an icy or snow packed road with any type unit which is equipped with this special snow and ice blade will break up all irregularities, ruts, etc., roughing up the roadway sufficiently to reduce



Shunk Saw-Tooth Blade Is Patented

the skidding hazard to a great extent. A second trip over the road will break up the frozen material to such an extent that it will thaw more readily. Two or more trips over the road, followed by a regular grader, in most cases will remove the frozen material.

On gravel and dirt roads and on shoulders of concrete and brick roads and where concrete or black top roads have been heavily sanded, it digs up a certain amount of sand and gravel, thereby eliminating need for further sanding.

Giant 8-Yd. Truck Mixers Built by Jaeger

The world's largest concrete mixers, a fleet of giant units that provide 8 cubic yard payload (equal to 16 tons of mixed concrete) are being put in service by The Colonial Sand & Stone Co., Inc., of New York City. They were developed by The Jaeger Machine Co., Columbus, Ohio, based on the highly successful "New York Special," $5\frac{1}{2}$ yd. model, over 150 of which are being operated in New York City.

The complete unit, mounted on six-wheel truck powered with 150 hp. diesel engine, stands 12 ft. high, is approximately 26 ft. long and weighs $31\frac{1}{2}$ tons when fully loaded. The mixing drum is driven di-



New Jaeger 8-yd. Truck Mixer

rectly from the truck engine and, by means of Jaeger Vacuum Control, the operator is able to start and stop the 16-ton load of the revolving drum merely by flipping a valve at the steering wheel.

Drum is equipped with two top charging doors. After enough material to produce five cubic yards of concrete is received through the first door, the machine then moves forward to bring the second door under the charging hopper where the remainder of the eight-yard batch is received.

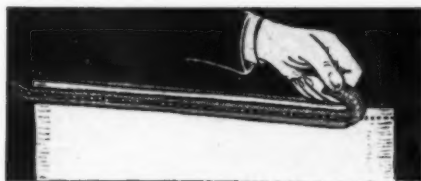
Total capacity of the water tank is 325 gallons, consisting of mix, flush and tem-

pering water, all of which are controlled from a single "Uni-Valve" panel on the tank. Special aluminum accuracy chamber encloses syphon shut-off in tank so that accuracy of water measurement cannot be affected by splashing or surging of main body of water.

New Cement Bag Opening Device

Bag Closure Corporation announces a new ripcord closure for cement bags. The new device permits use of one size of bag for cement of all degrees of fineness. Other advantages are: (1) Permits use of same bag for all types of cement, and with low cost of identification, (2) increases effective, useful capacity of small bags, (3) eliminates damage in opening bags, (4) eliminates cost of hemming bags, and (5) simplifies bag inventory.

This method of closure is applied by sewing a 70 lb. minimum tensile strength cord and paper strip across the end of the



Showing How New Bag Closure Makes Opening of Cement Bags an Easy Task

mouth of the bag. About a 2 in. loose extension of cord and paper is left at both sides of the bag. Removal or opening of the bag, is accomplished by grasping either loose end and ripping the stitches toward the other side.

Any desired printing placed on the paper will immediately identify the contents of the bag. Printing of code numbers or specification references would be an aid to those using the cements because of the variable types manufactured.

New Mack Truck

Pictured here, just before shipment, is one of Mack's newest truck models, a big LM six-wheel dumper, and one of three which have since been shipped to Nicaragua, Central America.

Equipped with 10-yard Gar Wood bodies having twin hydraulic hoists, two of these new trucks will work under Mr. Thomas A. Jones of the Public Roads Administration, Washington, D. C., who has been



Six Wheel 10 Yd. Mack Dump Truck

assigned to the Nicaraguan sector of the Pan American highway now under construction. The third big Mack six-wheel dumper like the unit shown has been delivered to Minera La India Cia. down in Nicaragua and will be used in mining operations.

New Double Bucket Carryall

Designed to give increased yardage with D8 tractor power, R. G. LeTourneau, Inc., has introduced the Model LU Carryall cable-controlled scraper with a struck capacity of 15 and a heaped capacity of 19 cu. yds.

Because of its large capacity and easy loading, the Model LU can be used behind the standard D8 tractor and loaded either with or without a pusher. This ability to work efficiently either with or without a pusher tractor makes this machine a valuable all around unit adaptable either to long or short hauls and singly or in fleet.

In order to make the Model LU adaptable for all types of job conditions, it may be equipped with a large variety of tire



The New Double Bucket LeTourneau Carryall

sizes. The front may have either two (13.50 x 20)s or two (18.00 x 24)s, the rear either 4 (13.50 x 20)s, two (18.00 x 24)s, two (18.00 x 40)s or two 2 (24.00 x 32)s.

An 8 ft. 6 in. blade width permits the moving of the scraper over highways and its operation on narrow fills.

For Better ROADS and STREETS



BITUVIA ROAD TAR—Because of construction and maintenance economies and because of its traffic safety BITUVIA road tar construction offers distinct advantages to the contractor and to the public. Deep penetration holds the aggregate firmly for long service. BITUVIA is easily applied. It is highly resilient and skid-resistant. Made in seven types to meet any Federal, State, County or Municipal specifications.



PLASTUVIA CRACK FILLER

The unusual ability of this filler to withstand a wide range of temperatures—from bitter cold to torrid heat—without flow or traffic "pull" in summer, or chipping in winter, makes it an outstanding product. The ease with which it is applied, and the manner in which it holds tenaciously to concrete and brick surfaces characterize this material. Your inquiry will bring you further information about these products.

REILLY TAR & CHEMICAL CORPORATION

Executive Offices: Merchants Bank Building, Indianapolis, Indiana
2513 S. DAMEN AVENUE, CHICAGO, ILLINOIS 300 FIFTH AVENUE, NEW YORK, N. Y. ST. LOUIS PARK, MINNEAPOLIS, MINN.
FIFTEEN PLANTS TO SERVE YOU

Koehring Announces New End Discharge 14-S Mixer

Of special interest to contractors are the latest developments now available with the Koehring 14-S Dandie. This mixer can now be adapted to all types of jobs, within the limits of its production capacity. For standard jobs, there is the 4-wheel side charging mixer. For the contractor having scattered jobs, the Trail-Mix is recommended because it can be moved at high speed, quickly spotted on the job, to pour directly to forms, chute or concrete carts.



New Koehring 14-S End Dump Mixer

And now, for the small paving jobs, such as alleys, courts, driveways and other slab areas, there is the 4-wheel end discharge 14-S Dandie. This machine is balanced to

permit high speed trailing without swaying. A special truck charging skip is available when required for certain job conditions. The skip has a low front and is 90 in. wide for easy loading with trucks. With all of these available combinations, Koehring can furnish any type of mixer required, with all the usual well-known special Koehring features, for special job conditions.

All of these models are powered with either an air-cooled or radiator-cooled engine. Electric motor can also be installed. Power is transmitted to the fully enclosed gear reduction by means of the multiple "V" belts. The gear reduction consists of an internal alloy steel gear and a steel case-hardened pinion. An adjusting rod on the gear case maintains the proper tension of the "V" belts.

Bearing Developed

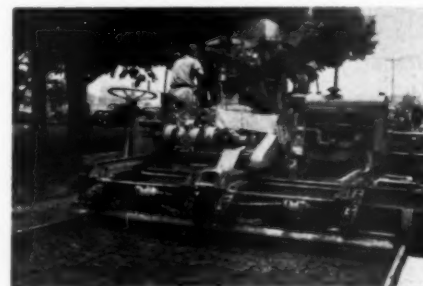
Realizing the difficulties encountered in trying to distinguish between the series numbers assigned to the various types of anti-friction bearing units, Link-Belt Company is humanizing the presentation of its five types by comparing them with prize fighters and re-classifying the group according to the various weights of fighters known to the ring.

The five different types are: Series 100 ball bearings, and Series 400, 500, 600, and 7200 self-aligning roller bearings.

The new classifications decided upon are: Flyweight for the Series 100; Welterweight, Series 400; Middleweight, Series 500; Heavyweight, Series 600; and Alternate Heavyweight, Series 7200.

Surface Type Vibrator Developed by Blaw-Knox

Blaw-Knox Company has developed a concrete vibrator of the surface type which may be operated in conjunction with either its new paving spreader or its finishing machine. The unit is a practical aid to the paving contractor in preventing voids or segregation, in simplifying the finishing operations, and in facilitating the use of stiff mixes with coarse aggregates.



A 12-ft. Blaw-Knox spreader-vibrator, with the vibrator at the rear, in operation on Dalton Bros. job in Pennsylvania

In no case has the use of the Blaw-Knox vibrator, either with the spreader or the finisher, detracted in any way from the ability of the contractor to obtain maximum production from his paving organization. Actually, it is found that final finishing, edging and jointing are expedited on the vibrated slab, thereby reducing overtime of cement finishers. Finally, vibration is most effectively and economically utilized when the mix is designed for vibration.

It Has Them Talking!

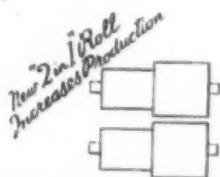
"Two-In-One" Secondary Crusher Increases Capacity of New "Pace-maker" Quarry Plant

Universal has "hit the gong again" with the NEW "Pacemaker" Portable Rock Crushing Plant. Equipped with 20"x36" (18" x 24" is optional) primary jaw crusher and the new unique "Two-In-One" Crusher for dual secondary reduction. You get the speed of three crusher reduction.

The Rotavator, rotary elevator, and underslung conveyor reduce the overall height and length, greatly minimize the weight and shorten the cycle from hopper to delivery conveyor.

From 100 to 130 yards of rock per hour crushed to 1" is a snap with the "Pacemaker"—performance that has contractors and highway officials talking about the first units that are now working.

Send for the facts—they'll have you talking, fool



New "PACEMAKER" Gives You

- Greater capacity with a smaller investment.
- Greater capacity with fewer tons of equipment.
- Complete portability—easy to move—easy on roads.
- More serviceable and economical Universal engineering throughout.

UNIVERSAL CRUSHER COMPANY ♦ 631 C Ave. West, Cedar Rapids, Iowa

UNIVERSAL

Complete New Line of Moto-Mixers and Moto-Agitators

A new line of REX "Hi-Discharge" Moto-Mixers and Moto-Agitators is announced by Chain Belt Company of Milwaukee. These truck-mixers are of entirely new design and have many revolutionary features—among them rear charging, a new mixing principle, and a high discharging point for greater spouting range—all designed specifically for fast up-to-date mixing and transporting of high quality, low slump concrete. As explained by the manufacturers, the new mixing



New Rex Hi-Discharge Moto-Mixer

principle makes the drum self-cleaning while mixing. The mixing action scours all parts of the drum because there are no inaccessible places for cement to build up and require unusual cleaning at the end of a day's run.

The new drum has one opening for both charging and discharging and uses that opening for both purposes—with no charging door to put on or off.

WITH THE MANUFACTURERS

Caterpillar Promotes Robison and Spain

Caterpillar Tractor Co. has announced two important advancements in the company's organization.

Donald A. Robison has been made a vice-president of the company with administrative direction of all selling and advertising activities. The office of general sales manager, which Mr. Robison leaves to assume his higher duties and responsibilities is being filled by the advancement of Gail E. Spain.

Mr. Robison, a native of Nevada, has been closely associated with Caterpillar Tractor Co. activities for many years. He was graduated from the University of Nevada with a business degree, and almost immediately went to work for the company. Since 1926 he has advanced rapidly through the various activities in the credit and treasury department, to the office of assistant treasurer, treasurer and then general sales manager.

Mr. Spain, who came from Portland, Oregon, and received the degree of Mechanical Engineer at Oregon State College, is widely known throughout the construction and agricultural equipment industries. In 1920 he went to work for the Williamette Iron & Steel Works at Portland, and during his nine years with that concern advanced through the engineering and sales departments. For two years before coming to "Caterpillar," Mr. Spain was Williamette's Sales Manager.

In 1929, he joined the "Caterpillar" organization at San Leandro, California, being transferred to Peoria, Illinois, in the summer of that same year. First a logging representative for the company, Mr. Spain later held positions in the Merchandise, Engine Sales and General Sales departments. Since 1938 he has been Manager of the Sales Development Division.



D. A. Robison



Gail Spain

World's Largest Fence Order Filled by Pittsburgh Steel Company

The largest single fence order ever placed was recently awarded to Pittsburgh Steel Company, Pittsburgh, Pa. for erection along both sides of the right of way and interchanges of the all-weather Pennsylvania Turnpike. More than 320 miles of heavy gauge Pittsburgh welded joint fence and approximately 8 miles of Pittsburgh chain link fence was erected by this company to specifications by the Pennsylvania Turnpike Commission. The entire installation involved the use of approximately 995 tons of wire fabric and top-strand wire, and 705 tons of steel posts, gates and fit-



Pittsburgh Welded Joint Fence Installed On Pennsylvania Turnpike

tings. Additionally, some 128 tons of pure zinc comprises the protective coating which

shields the fence from ravages of the elements. Applied to the wire fabric by the charcoal-wipe process, this heavy-uniform zinc coating assures long, satisfactory life.


All the wire fabrics involved in this installation is of copper-bearing steel, of special analysis for fence purposes, heavily coated with pure, ductile, non-cracking zinc. The total weight of the complete fence is 3,400,000 pounds with a combined length both welded joint fence and Pittsburgh chain link fence of approximately 330 miles.

Correction

In the November issue of *ROADS AND STREETS* we listed the wrong address for the Marvel Equipment Manufacturers. Their correct address is 226 So. Michigan Ave., Chicago, Ill.

Parmanco

HORIZONTAL DRILLS



Stop . . . AND THINK!

That cutting pavements causes more damage than traffic.

That trenched yards are eyesores for years.

That public hazard can be eliminated.

That obstructing traffic is not necessary.

That you now can put services in to grade.

That you can save money, time and create good will by using PARMANCO.

PARMANCO Utility Drills are made in two sizes, PARMANCO JUNIOR

for drilling 4 inch holes up to 50 feet, and the PARMANCO GENERAL

UTILITY for drilling longer distances or drilling larger holes.

ALSO PARMANCO SENIOR for drilling up to 14" holes.

Write us for details of actual performances during last 30 days.

WRITE US YOUR DRILLING PROBLEMS

PARIS MANUFACTURING CO., INC.

PARIS, ILLINOIS

NOVO BREAKER

PAVEMENT Demolishing Trimming & Cutting



BREAKING

The results obtained with the Novo Breaker in breaking up pavements, bridge floors, drives, curbs, etc., have proved beyond a doubt that here is the fastest, cheapest breaking method.

CUTTING

Hammer equipped with shearing knife is used for trench work, cutting without breakback in reinforced concrete. Also used in frost & trimming.

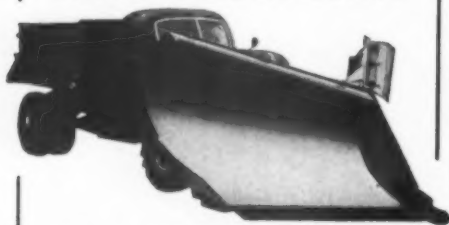
COSTS

Let us tell you the surprisingly low cost figure at which pavements can be broken by this method. It mounts on your truck. Send for information.

246 Porter St.

NOVO ENGINE COMPANY
LANSING, MICHIGAN

There's a Difference



Between "bulldozing" and plowing snow; bulldozing is merely pushing the snow which takes plenty of power, while plowing snow picks it up and rolls it. That is why Ross PLOWS with "Sno-Flo" moldboards will move more snow with fifty percent less power.

Ross plows have gained an enviable reputation in the snow belts of the United States and Canada because of operating efficiency.

Ross plows and wings are available for all trucks and tractors.

Manufactured by

THE BURCH CORPORATION
Crestline, Ohio

Builders of Equipment for Fifty Years

Worthington Pump Appoints New Traffic Manager

R. A. Travisano, a member of the Traffic Club of Newark, N. J., well known to railroad and steamship officials in the New York metropolitan area, succeeds the late Mr. H. T. Smith as traffic manager of the Worthington Pump and Machinery Corporation.

Mr. Travisano entered the employ of Worthington in 1912 as a stenographer. In 1915 he was transferred to the local traffic department at the Harrison Works. He was moved to the general traffic department in the New York offices of the organization in 1924, to handle the clearance of all exports of the corporation, as well as his regular duties of traffic department routine. Upon completion of the executive offices of the corporation at Harrison, N. J. in 1933, Mr. Travisano returned to the Harrison Works to become assistant to the late Mr. H. T. Smith.

Mr. Travisano, who lives at 41 Midland Place, is a life long resident of Newark. He attended Newark Public Schools, and is a graduate of the Merchants and Bankers Business College of Newark.

H. H. Timken, Sr., Dead



H. H. Timken, Sr.

H. H. Timken, Sr., Chairman of the Board of The Timken Roller Bearing Company, died Monday, October 14, in his home at Canton, Ohio. The immediate cause of his death was pneumonia, which developed from chronic asthma. His illness was of short duration.

Although still active in the business which he founded with his father and brother, in 1898, his two sons, H. H. Timken, Jr. and W. Robert Timken in recent years have taken an active part in the management of the company.

Mr. Timken became active head of the plant. At this time he had no salesmen so he took to the road himself, leaving the operation of the plant to his brother and assistants. Many cars already were in production and others were being designed in scores of little machine shops in and around Detroit. Mr. Timken visited them all and between visits to the factories already producing automobiles, he called on designers in machine shops, selling them the idea of using the Timken Tapered Bearing.

Mr. Timken was a philanthropist and benefactor to many and varied charitable institutions and welfare agencies. Most recent of his gifts is the new Canton Timken Vocational High School, built and furnished with the most modern equipment. It was begun in the fall of 1937 and was completed for the opening of the 1939-1940 school year, at a cost of approximately \$1,500,000. Today it is recognized as the finest school of its type in the country.

Survivors are Mrs. Timken; three sons, Henry H., Jr., W. Robert, and John; a brother, William R. Timken; a sister, Mrs. Cora B. Burnett, and two grandchildren.

George W. Curtis Heads Timken Milwaukee Division



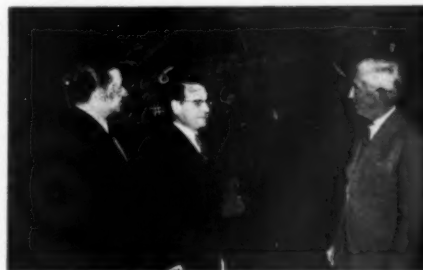
Geo. W. Curtis

Officials of The Timken Roller Bearing Company this week announced the appointment of George W. Curtis as the Milwaukee Division Manager. Industrial and automotive bearing sales as well as alloy steel sales activities of this division will be under his supervision.

Since Mr. Curtis' graduation in 1920 from Carnegie Institute of Technology he has served in important engineering and sales capacities at Canton, Ohio, and Pittsburgh, Pa. Upon his transfer from Pittsburgh to Milwaukee in 1930 he was made District Manager of the Industrial Division in which position he has become widely known for his work in the application of Timken bearings to all types of automotive, agricultural and industrial equipment and also for his contribution to the design of power transmissions.

One Good Visit Deserves Another

When Gar Wood, President of Gar Wood Industries, Inc. visited Rio de Janeiro, recently, he exacted a promise from one of his Brazilian friends for a return visit to him in the United States. And here they are, photographed in the Gar Wood factory's Road Machinery Division, Detroit. Shown left to right are: Darke Behring Mattos, 37-year old industrialist and an intimate of President Getulio Vargas of Brazil, from whom he carried a letter to President Roosevelt; Ouido Abreu, who is accompanying Mr. Mattos on his trip, is financial secretary of the State of Minas



Left to Right: Darke Behring Mattos, Ouido Abreu, Gar Wood. Brazilians Return Mr. Wood's Visit

Geraes, largest in the Brazilian republic; and Gar Wood, the host. Darke Behring Mattos and Gar Wood have many things in common; both own large planes, both are ardent pilots and both active industrialists. Mr. Mattos, who made the trip via his plane, is a leading coffee and chocolate producer; Gar Wood's manufacturing activities include hoists and bodies, truck tanks, winches and cranes, air conditioning, road machinery and boats.

NEW TRADE LITERATURE

Granitiron Culverts an Drainage Products is the title of a new loose leaf fixed binding colored brochure by the Granite City Steel Co. The book is replete with illustrated installations and tables of useful data on culverts and drainage problems. Entrance culverts, bridge replacements, suburban sub-division drainage, hillside roads, street and municipal, jacking, extending old culverts, special shapes, wash checks, N-arch construction, cattle passes, connectors, subdrainage and drainage gates are among the many topics voluminously illustrated and concisely discussed.

Engineering and drainage data at the end of the book will prove valuable for solving drainage problems.

For a copy of the well prepared book write the Granite City Steel Co.

Saxe Welded Erection System is the title of a bulletin which describes a new way in which money can be saved when erecting welded steel structures.

Saxe Welded Connections were developed by Van Rensselaer P. Saxe, Consulting Engineer, Baltimore, Md., at the request of steel fabricators, for a more economical method of steel erection. The connections definitely reduce costs where steel members must be located and held firmly in place for welding.

During the past ten years prominent architects, engineers and other users of Saxe connections have endorsed their use as a dependable, speedy and economical method of steel erection. These patented Saxe welded connections, manufactured and sold exclusively by J. H. Williams & Co., are described in their Bulletin No. 1.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., just released a new catalog of their new "HD 7" diesel crawler tractor. The catalog is different from the ordinary run of catalogs as its approach is new and unusual. Written in conversational tone and simulating a letter, the whole catalog is printed in typewriter type.

Stressing performance to do the job and protection against lost time, this 24-page, 2-color catalog emphasizes the five main features of 54 hp tractor:

1. Two-cycle diesel power
2. Balanced power and speed
3. Bi-metallic clutches and brakes
4. New track release mechanism
5. "Positive-Seal" truck wheels

Many cut away drawings and schematic pictures as well as pictures of tractor parts illustrate the descriptive matter. The booklet is well prepared. It may be obtained by writing to **ROADS AND STREETS**

Koppers Membrane Waterproofing.—Technical literature describing waterproofing and dampproofing of concrete and brick foundations, precast concrete piles or slabs, and for waterworks and sewage disposal plants, has just been published by Koppers Company, Tar and Chemical Division.

"Membrane Waterproofing" (Form TB-3) tells when waterproofing and damp-proofing should be applied. The respective values of fabric and felt are described and methods of application are pictured and discussed.

New Solvay Literature on Calcium Chloride for Winter Concreting.—A new folder on the benefits obtained by the use of Solvay calcium chloride with all Portland cement poured at or below 50 deg. F. has just been announced by the Solvay Sales Corporation.

This folder stresses the fact that nine separate advantages are obtained when calcium chloride is used in the cold weather concrete mix. They include lower concreting costs, quicker set, high early strength, greater final strength, extra cold weather protection, uniform curing, shorter protection period, less forms and equipment, increased density and hardness. Data taken from tests conducted by the National Bureau of Standards and the Portland Cement Association are referred to in proving the statements made. Emphasis is laid on the fact that calcium chloride may be used with all types of cement and for all types of construction.

Copies may be obtained without charge by writing to Solvay Sales Corporation and asking for the folder entitled, "Get These Nine Advantages in Winter Concreting by Using Solvay Calcium Chloride," or to **ROADS AND STREETS**.

Aeroil Winter Construction Equipment.—All within the covers of one loose leaf spiral bound book the Aeroil Burner Company, Inc., West New York, New Jersey, has included a complete catalog of winter heating equipment for contractors. Bulletin 208 describes the company's concrete heaters, Bulletin 210—portable coil hot water heaters, Bulletin 212—"Smokeless" oil burning salamanders, Leaflet 377R—live steam thawing outfits, Bulletin 170—2000 deg. flame thawing torches, Leaflet 287—ground thawing equipment, and "flat flame" weed burner, Leaflet 365—portable 2000 deg. torch outfits. The booklet is fully illustrated and price quotations given for the various units.

Earth-Moving Cost Calculators.—To assist contractors, engineers and all interested earth-movers to rapidly compute probable production for cost estimates and analyses, the Field Engineering Department of R. G. LeTourneau, Inc. has prepared a handy, simple slide rule Calculator based on exhaustive time studies and compilation of extensive job data.

With the Calculator you can quickly answer all questions on probable performance by LeTourneau Carryall scrapers, powered by "Caterpillar" tractors including optional units as well as the most recent D7, and by the Model A Tournapull and trucks. Production is easily computed over any grade or haul distance, and provision is made for average speeds as great as 40 mph.

While prepared primarily for LeTourneau tractor-drawn and Tournapull equipment, this instrument is useful in computing probable production of any earth hauling equipment.

This precisely engineered, attractive and highly useful estimating instrument is available free of charge at all LeTourneau and "Caterpillar" Dealers or by writing Field Engineers, R. G. LeTourneau, Inc., Peoria, Ill., or to **ROADS AND STREETS**.

"THIS BUCKET'S GOT WHAT IT TAKES"



' Tearing out this old Baldwin Locomotive Works foundation at Philadelphia was about as tough a test as a bucket ever gets. Wm. Geppert, Inc., owners of the bucket, report that the 1/2-Yard Williams Multiple Rope did an extraordinary job in digging into and removing the massive stone and heavy chunks of concrete.

Powerful in biting and gripping, fast in action, and ruggedly built with welded construction at vital points, Williams Buckets are without a superior for hard service.

Bulletins describing all types of Williams buckets sent FREE on request.

THE WELLMAN ENGINEERING CO.

7003 Central Avenue
Cleveland, Ohio

WILLIAMS
Buckets
built by WELLMAN

"Established in 1885"

**For LOW COST
LARGE PRODUCTION**

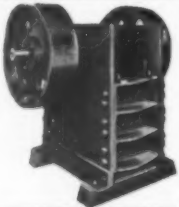
you can depend on

GRUENDLER EQUIPMENT

(FREE—Write for our 16 page
Catalog and Specifications)

**JAW
CRUSHERS**
Bronze or Roller
Bearing

Heavy armor plate
steel or cast steel.
Heavy Duty
Construction
Large capacity
Small power
Requirements



**Self Traveling Tractor
JAW
CRUSHERS**

Ideal for
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BISMARCK
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RANDOLPH AND LA SALLE

Adams Motor Graders.—In an attractive 20 page two color booklet, J. D. Adams Co., describes and illustrates their No. 501 and No. 511 motor grader. The difference in number refers to diesel power. The machine is well described and cutaway diagrams illustrate particular features. All of the information a contractor or engineer might want to know about this motor grader is included, except price. The catalog resembles some of the fine printing and art work done by automobile manufacturers for advertising their new models.

Phantom views, schematic drawings, and line drawings of individual features are followed by a page of specifications. The booklet is available upon request.

Worthington Portable Compressors is the title of a new bulletin H-850-B52B just issued by the Worthington Pump and Machinery Corporation, Harrison, N. J. The bulletin lists and pictures the company's varied line of portable gasoline engine driven compressors. The main center spread shows the picture of a rubber tired portable unit built in sizes as follows: 60, 105, 160, 210, 315 cu. ft. of air delivered. Specifications are included in the bulletin.

Blaw-Knox Bucket Catalog, 1757.—Culminating a three year program of bucket redesign and standardization, Blaw-Knox Company, Pittsburgh, Pa., has prepared a comprehensive 36 page catalog on its series of two-line lever arm clamshell buckets. A total of 242 individual bucket specifications are involved. These have been planned with a systematic relationship between units according to service and the complete series accommodates operating conditions in a wide field of service. As a result of the program, the company reports savings in engineering and manufacture together with better value and service to bucket users. Moreover, the problem of selecting the best performing and most economical bucket for a given job is thus simplified.

The 242 buckets are listed in a consolidated table according to rated capacity, ranging from 1/8 to 7 1/2 cubic yards. This table records the service classification of each bucket, lists dimensions and physical data, and gives, in many instances, the approximate cubic feet performance on different classes of material.

Copies of this catalog (No. 1757) and of the recently issued "Buckets for Single Drum Hoists" (No. 1696) may be had upon request. Write ROADS AND STREETS or the manufacturer.

Farm to Market Roads is the subject content of the May, 1940, issue of *Modern Power Farming*, a publication of Allis-Chalmers Manufacturing Co., Milwaukee, Wis. The subject is discussed under the following headings: Planning; Farm-to-Market Road Standards; Drainage; Road Stabilization with Tar; Road Stabilization with Calcium Chloride; and Road Stabilization with Soil-Cement.

Each heading is briefly discussed in as non-technical language as possible. Illustrations compare old methods of hauling or doing road work with methods which use Allis-Chalmers products.

New P&H Excavator Described in Booklet.—Coinciding with the appearance on the market of the new P&H 255-A excavator is the publication of a 24-page booklet describing the machine, issued by the manufacturer, the Harnischfeger Corporation.

The P&H 255-A is a 3/4 yd. machine featuring the new P&H hydraulic control. This control, although standard in the automotive industry for more than fifteen years, makes its first appearance in the excavator field in P&H excavators up to 3/4 yd. capacity. The booklet, called Bulletin X-71, describes the control, as well as other features of the machine.

Discussed, and illustrated with numerous photographs and diagrams are the machine's tractor-type crawlers, all-welded construction, three-speed transmission, the patented P&H chain crowd, and many other features of interest to contractors and engineers.

Copies of Bulletin X-71 may be obtained by addressing the Harnischfeger Corporation.

The Owen Bucket Company, 5500 Breakwater Ave., Cleveland, Ohio, has just published a comprehensive, profusely illustrated, instructively detailed booklet on their Owen Grapplers. This booklet should be in the files of all users of power cranes or derricks. Pictures show the multitude of ways in which the grapple buckets handle materials.

The booklet contains specifications of sizes, capacities, dimensions, weights, etc.

MacWhyte Wire Rope is described in a general way in a recently prepared two color broadside released recently. It is prepared as a tribute to the Pennsylvania Turnpike contractors and describes the rope manufactured by MacWhyte that was used on the Turnpike.

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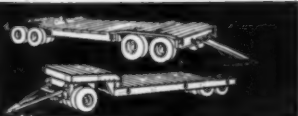
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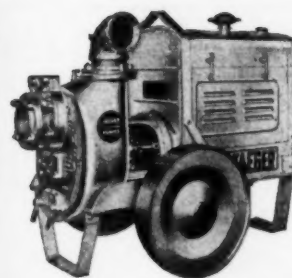
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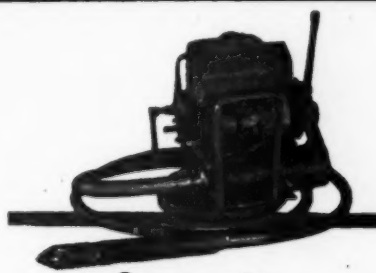


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